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ABSTRACT

This guide is designed to be used by local curriculum planners and technology education teachers responsible for the development, implementation, and evaluation of a technology education program. It offers recommendations that reflect the thinking of technology education leaders in Wisconsin and across the nation. The guide is intended to provide a framework for the development of a comprehensive technology education program, not simply a sequence of courses in a single system. The guide is based on a balanced treatment of the four major systems of technology; communications, construction, manufacturing, and transportation. The guide provides a strategy for early introduction of broad concepts of technology, followed by increasingly more narrow and focused instruction in specific technological systems, a curricular design that culminates with occupational preparation strands for upper level courses. Chapters include: (1) "Philosophy and Framework"; (2) "A Planning Process"; (3) "Influences on Curriculum"; (4) "Curriculum Development"; (5) "Content Development"; (6) "Delivery Systems"; and (7) "Resources and References." Appendices describe student outreach, taxonomies for the four systems, standards, and sample forms. A content display chart depicting the organization of technology education is provided. (YP)

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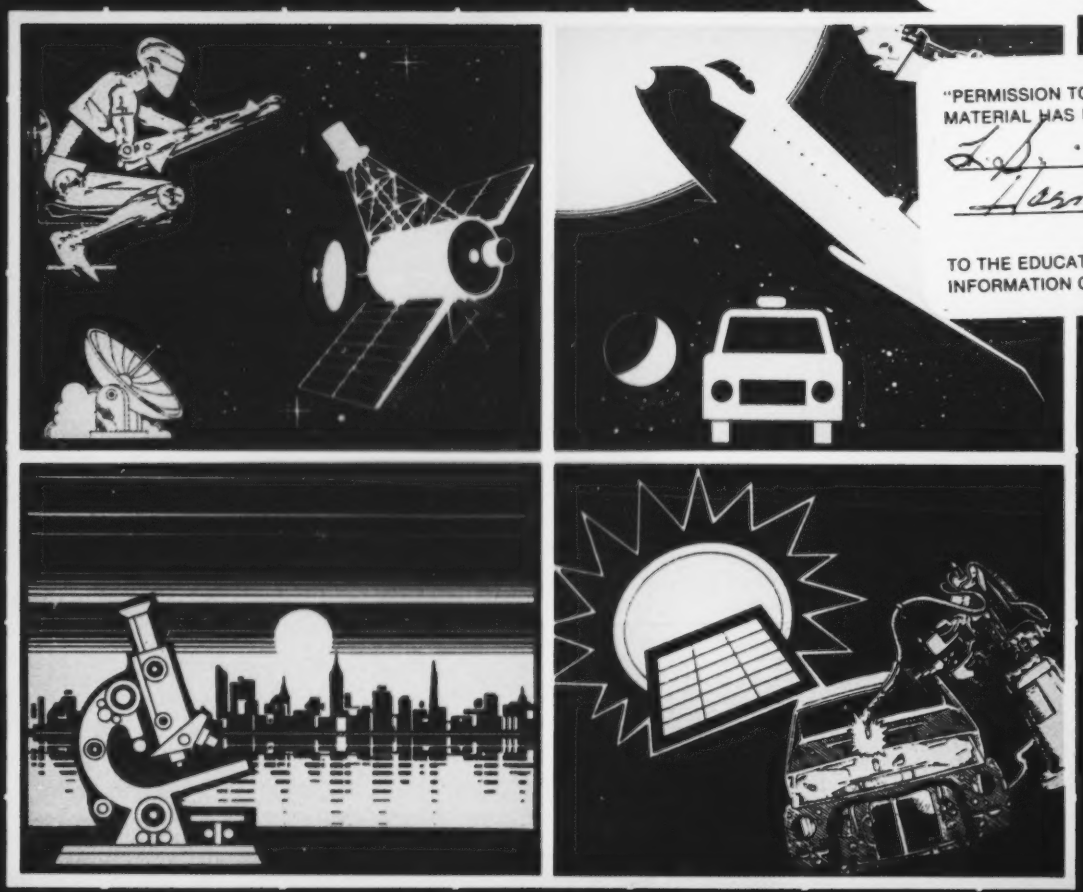

Wisconsin Department of Public Instruction
Herbert J. Grover, State Superintendent

SE 050 442

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Foreword

The United States—indeed, the world—is in the midst of enormous technological change that is drastically affecting the way we live and work. If we are going to direct technology for the good of all citizens, people must understand technology as an integral part of their everyday lives. That's why teaching about technology and its impact on all of us is of vital importance at all grade levels in our schools.

This is a time of transition during which some of the conventional characteristics of industrial arts programs are being incorporated into teaching about technological concepts, processes, and systems. Contemporary technology education programs must teach about present and future technology while continuing to provide students with opportunities to

- apply tools, materials, machines, and processes safely and effectively;
- experience contemporary activity-oriented laboratory instruction designed to reinforce abstract concepts with concrete activities;
- develop the skills, creative abilities, positive self-concepts, and individual capabilities to use various technologies;
- understand technology as a base for career opportunities;
- develop problem-solving and decision-making abilities; and
- develop a positive attitude toward lifelong learning.

A Guide to Curriculum Planning in Technology Education presents a contemporary framework for technology education programs. Its content is drawn from the four generally recognized systems of technology—communications, construction, manufacturing, and transportation. While there are other ways of subdividing the content, the task force that developed this guide drew specifically on work from the Jackson's Mill project and from the Technology Foundation of America's publication, *Industry and Technology Education: A Guide for Curriculum Designers, Implementors, and Teachers* (Lansing, IL: TFA), in devising an organizational scheme. However, the task force carried the recommendations beyond these projects to include an occupational preparation strand for upper-level courses. This guide also recommends a continuous introduction to careers in the various systems of technology, which fits particularly well with the thrust of the Education for Employment initiative of the Department of Public Instruction.

It is important for users of this guide to remember that it is a *guide* to curriculum planning, not a *mandate*. The task force believes it has based its recommendations on current research and planning and has thoughtfully presented a structure for a comprehensive technology education program for a variety of school organizations and sizes. Still, local Wisconsin administrators, supervisors, vocational education coordinators, and teachers must evaluate the recommendations and make the final decisions as to what constitutes appropriate course content and structure for their own local districts.

Herbert J. Grover
State Superintendent

Acknowledgments

This guide is the result of the intense concentration and labor of many people over the past few years. One group, however, deserves special thanks. They are the members of the technology education curriculum development task force appointed by State Superintendent Herbert J. Grover. They spent many hours determining the content and organizational structure of the guide and drafting sections and course descriptions. They also arrived at a consensus on the substance and design of the technology education content chart that provides the conceptual basis for this guide and its four companion activity compilations.

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Thanks are also due to John Vanderhoof, former Department of Public Instruction technology education consultant, for his part in planning and organizing this curriculum guide, and to Eunice Bethke, chief of the Consultation Section, who facilitated the preparation of the manuscript. Kathleen D. McCleave, editor of this guide, deserves very special acknowledgment for her insight, patience, and guidance in the revision of earlier technology education materials and in the development and final editing of this publication. Other staff members of the Department of Public Instruction who provided valued assistance are Danni Jorenby, word processor/typesetter; Neldine M. Nichols, photographer; Vicky Rettenmund, graphic artist; Barbara Sumwalt, technology education program assistant; and Kris Whitman, proofreader. The cover graphic was provided by Joan Vissers, a member of the state's Technology Education Advisory Council.

Introduction

A Guide to Curriculum Planning in Technology Education is designed to be used by local curriculum planners and technology education teachers responsible for the development, implementation, and evaluation of a technology education program. It offers recommendations that reflect the thinking of technology education leaders in Wisconsin and across the nation.

The guide is intended to provide a framework for the development of a comprehensive technology education program, not simply a sequence of courses in a single system. The guide is based on a balanced treatment of the four major systems of technology—communications, construction, manufacturing, and transportation.

The guide provides a strategy for early introduction of broad concepts of technology, followed by increasingly more narrow and focused instruction in specific technological systems, a curricular design that culminates with occupational preparation strands for upper-level courses. The guide recommends a continuous introduction to careers in the various systems of technology.

As an aid to clearly placing the concepts of technology in the total context of the discipline, a content chart has been devised. This chart graphically depicts the content organization of technology education that was first advanced in the subject taxonomies in the Technical Foundation of America's publication, *Industry and Technology Education: A Guide for Curriculum Designers, Implementors, and Teachers* (Lansing, IL: TFA). The accompanying large, colored version of the content chart is intended for display on a classroom wall.

As supplements to this guide, the Department of Public Instruction also prepared four separate compilations of classroom activities—one for each major technological system. The activities in these companion books also follow the organizational structure given in this guide and summarized in the content chart. The activity books are available separately from the DPI. It is hoped that, taken together, these materials will provide timely structure for the efforts of local curriculum committees as they review and revise their technology education programs. We can best serve our students' critical need for technological literacy in this century—and the next—by making certain that our curricular offerings remain on the cutting edge of this evolving discipline.

Philosophy and Framework

Introduction
Philosophical Base
Content Organization: A Synthesis

Introduction

Rationale

"Few people will argue that the advancement of technology has not affected the nature of one's life and educational needs."
–Starkweather, 1979

During recent years, technology has advanced at an unprecedented rate. In just the last century, over the life span of many living individuals, we experienced an era of agriculture, then industry, and now information. We are becoming more of a global community because of our ability to communicate and travel. Lifestyles, values, and relationships have already changed; now, even our work is changing.

The major force driving this change is technology. Although this is not the only force to consider, it is one major force shaping the way we live and work. When any one factor has such a significant impact, it is essential that it be understood by everyone. For this reason, technology education should be included as an integral part of every school program in the state of Wisconsin. It is *the* discipline best suited to deliver technological understanding to all students. The mission of technology educators, therefore, is to

- interpret technology—its past, present, and future;
- assess the impacts of technology on individuals and society; and
- organize and deliver appropriate, action-oriented, learning experiences for all students.

Program Objectives

. . . if we list literacy, exploration, *and* preparation, *we better convey what the program specifically will do for students.*

The overriding objective of technology education is technological literacy for all citizens. We all need to be technologically literate to some degree, although some of us will have different levels of need. For example, we all need a basic level of understanding to cast intelligent votes on issues and candidates for office, but some may need a higher level to make wise investments. Still others need very high levels of technological understanding to function in roles such as engineers, architects, and researchers.

The purpose of stating specific objectives is to focus the meaning of technological literacy. If we list *literacy* as an objective, we leave the discipline open to different interpretations. But, if we list *literacy*, *exploration*, and *preparation*, we better convey what the program specifically will do for students. The objectives for technology education, therefore, are to provide students opportunities to

- better understand technology;
- develop an understanding of the relationships between individuals and society;
- explore interests and opportunities related to technology;
- prepare for entry into chosen technology-related occupations; and,
- develop a technological base for continued learning.

Direction can be determined from program objectives. For example, when the word "technology" appears in the statement of objectives, it suggests that technology is the major focus of study. Using the word "society" implies that technology should not be studied in isolation from the context of a world community. "Explore" suggests a broad comprehensive study of technology. And, if a student is going to "prepare" for a career and continued study, then it is necessary to examine real employability attributes.

Direction can be determined from program objectives.

Philosophical Base

Jackson's Mill Theory

Examining program-level objectives is probably the best way to determine what should be taught as part of technology education. We often hear familiar suggestions, including problem solving, creativity, flexibility, adaptability, transferability, attitudes, and applications of other subjects. While these are desirable, they are not unique to technology education or even to technological literacy. Even if these items were to be addressed, furthermore, that would have to be done in some context. Specifically delineating that context, both philosophically and practically, is one of the major purposes of this guide. We want to provide a blueprint for technology education—one that is meaningful to educators, administrators, and parents. We are suggesting that at the present time the context of technology education is best found in a clarification and simplification of the human adaptive systems that were identified in the Jackson's Mill curriculum effort.*

Specifically delineating . . . context, both philosophically and practically, is one of the major purposes of this guide.

The Jackson's Mill curriculum theory probably is *the* most notable curriculum effort in the field today. This project identified what is becoming the most widely accepted content organization since "woodworking, metalworking, and drafting." In addition to bringing the profession very close to agreement on the content base, the effort also helped put technology into perspective.

For example, the Jackson's Mill symposium identified "domains of knowledge" and "human adaptive systems" as a means of viewing human beings and their relationship to their social and natural environment. The domains of knowledge are the *sciences*, the *humanities*, the *technologies*, and *formal knowledge* (represented by language, linguistics, mathematics, and logic, which provides form and structure to the other three domains). Together, they provide the knowledge base that enables us to manage our environment.

It is noteworthy that one of these domains is the technologies. This suggests that there is a body of knowledge that is technological. Viewed

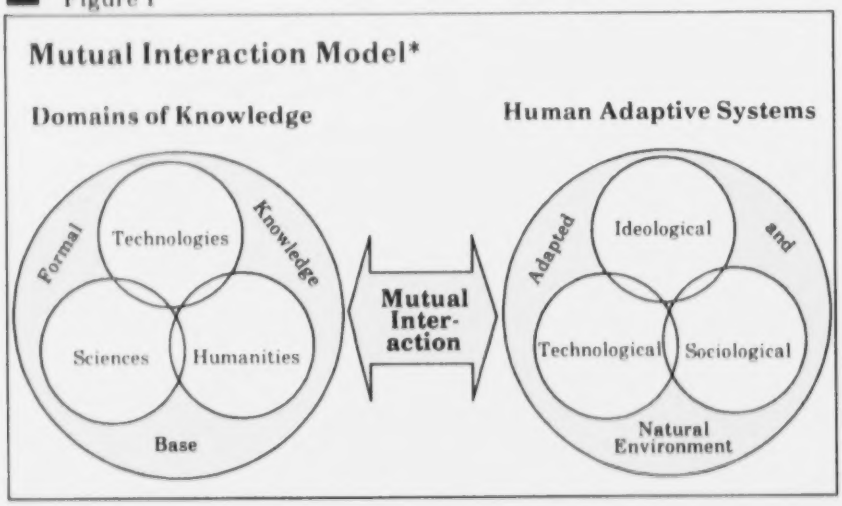
*James F. Snyder and James A. Hales, eds., *Jackson's Mill Industrial Arts Curriculum Theory* (Charleston, WV: Department of Education, 1981).

"What is lost in the over-specialization is the sense of the larger picture, of the inter-relationship among disciplines and among different kinds of events in the outside world."
–Stivers, 1983

in this light, technology is the set of processes by which we manipulate, change, and control the material world to satisfy human needs. To develop our technology, we draw upon the other domains of knowledge. In turn, however, as we advance our technology, we expand our knowledge base. The domains of knowledge thus are truly interactive and dependent upon one another for growth and development.

Likewise the three human adaptive systems—*ideological* (concerned with the values and beliefs of society), *sociological* (patterns of behavior characterized by social organization and regulation), and *technological* (manipulating the physical world to meet basic and perceived needs)—are interrelated and exist within our adapted and natural environment. The complex inter- and intra-relatedness of our knowledge base and our adaptive responses is expressed in the Jackson's Mill "Mutual Interaction Model," shown in Figure 1. It conveys the idea that as we discover more knowledge, we adapt in better and improved ways; as we devise more appropriate adaptations, we enhance our domains of knowledge.

Figure 1



This interaction requires that as we teach technology in our schools, we must also consider the other domains of knowledge and integrate many of their important concepts along with concepts of technology. It is necessary, for example, to draw upon principles of science, apply mathematics, and use language in our technology education curriculum. Conversely, other disciplines rely heavily upon technological concepts in their teaching.

*Adapted from James F. Snyder and James A. Hales, eds., *Jackson's Mill Industrial Arts Curriculum Theory* (Charleston, WV: Department of Education, 1981).

The model suggests that we have always adapted our environment to suit our needs and desires. As we developed needs to exchange ideas and information, and to move ourselves and things from one location to another, we created systems of *communication* and *transportation*. As we developed needs to produce products for our consumption and comfort, and to shelter ourselves and our possessions, we also created systems of *manufacturing* and *construction*. We enhance these systems through technology to extend our potential as human beings, and thus, to satisfy some of our material needs.

"Our society has achieved its high material standard of living by using industry and technology together, as demonstrated by developments in communications, construction, manufacturing, and transportation."
– Hales and Snyder, 1982

In concert with the Jackson's Mill theory, this guide promotes these four technological systems as the common base of content for technology education. As more work is done and the discipline matures, better organizers may emerge. In the meantime, these adaptive systems are logical, understandable, and acceptable; they provide an appropriate transition from industrial education to technology education.

Building on this premise, we need to teach about these systems and about the productive and managerial processes, resources, and outputs revolving around them. That is the content. We especially need to teach conceptually by sorting out and presenting key ideas about technology and through "first-hand" laboratory experiences. This is not a new idea, but one to which we need to pay more attention. As the content of technology education changes, so must the methods by which content is taught. One thing is stable; as we teach technology, we must draw from other disciplines just as surely as technology itself enhances the other domains of knowledge in the timeless interaction of knowledge and response.

Processes Model

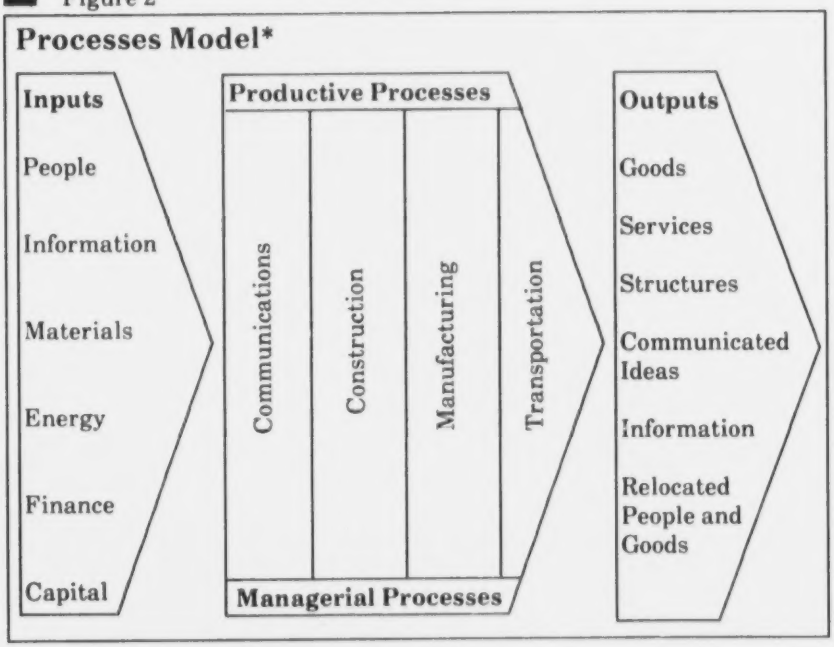
The major concepts of the four technological systems can be put into common perspective by use of a processes model (Figure 2). The model shows the relationship of *inputs*, *processes*, and *outputs*. It is a systems model; that is, there are several parts working to accomplish some task or objective. Considering the model from left to right, the inputs are listed first, processes second, and outputs third. Resources or inputs must be available for a system to function. When the resources are processed, an output can be created.

Inputs are the resources that, when processed, produce the desired outcomes. The use of each input will depend on the expected outcome. Some outputs will require one combination of resources, while other outcomes will require a different set of inputs. Inputs are a stable part of all systems. Although they are used differently in each system, they are always present before the system can operate.

. . . technology is the means by which resources are brought together and processed to produce an outcome.

Processes are really technical means. This is the part of a system where the right combination of inputs is brought together to produce a desired output. In this context, technology is the means by which resources are brought together and processed to produce an outcome.

Figure 2



Outputs of a system are the goals or tasks to be accomplished. This is what is accomplished when the inputs have been processed in one of the systems of technology. The results can be in the form of goods or services. Note also that some outputs might be undesirable on occasion, such as air or water pollution or radioactive waste.

Technical Foundation of America Guide

. . . more work was necessary before the theory could be put into practice.

Most professionals in the field agree that the Jackson's Mill theory was an excellent and timely piece of work. It made a major contribution. However, most also agree that this pioneering effort was mainly theory and that more work was necessary before the theory could be put into practice. As a result, a project was funded by the Technical Foundation of America (TFA) to translate this theory into practice. The publication *Industry and Technology Education: A Guide for Curriculum Designers, Implementors, and Teachers* (Lansing, IL: TFA) resulted from that project.

The TFA guide presents four detailed taxonomies, one for each technology education system—communications, construction, manufacturing, and transportation. From these taxonomies, content was selected and organized into about twenty sample courses. Each course presented in the guide is complete with a description, objectives, content, and representa-

*Based on a model appearing in Leonard Sterry, "A Relationship Between Technology Education and Trade and Industrial Education (Part 2)," *The Technology Teacher*, February 1987, p. 12 (adapted for the Department of Public Instruction by the author).

tive learning activities for students. In addition to the taxonomies and courses, curriculum models are presented for large, medium, and small programs.

Many school districts and several states have adopted the taxonomies and program models presented in the TFA guide, although the models sometimes are adapted to satisfy local philosophies. However, the original integrity is usually maintained.

Content Organization: A Synthesis

Scope: Content Chart

This Wisconsin guide also adopts in concept much of the work that was done by the committees that developed the Jackson's Mill theories and the TFA guide. These efforts have been merged and simplified, however, to suit our Wisconsin philosophy. As a result, the taxonomies have been condensed, the courses modified, and the models reorganized. Referring to Figure 3, the fold-out chart, "Technology Education Content," will give the quickest overview of our approach to content organization within the four major technological systems. It provides five vertical content divisions (beginning with the first "Technology" box) organized through the four horizontally-depicted major technological systems. *(It is important to distinguish that these taxonomies represent the content that is technology and not necessarily how a program of technology education should be organized.)* The detailed original TFA taxonomies, from which our content chart is drawn, appear in Appendix B.

Another significant change in our approach is that Wisconsin emphasizes the objective of occupational preparation, which was not addressed by either the Jackson's Mill theorists or the TFA guide. Addressing occupational preparation along with technological literacy, and exploring technology education as a single discipline are the cardinal differences between this and previous efforts.

"As our technological prowess continues to expand exponentially on a global scale, we will ultimately need a totally new discipline in the educational system."
–The Technology Teacher, Donald P. Lauda, 1984

Figure 3

Technology Education Content

This chart graphically depicts a content organization for the four major systems of technology—communications, construction, manufacturing, and transportation. Within each system, major instructional concepts are identified by number and letter and their specific subject matter is detailed.

The chart is the basis of the technology education program and content models presented in this guide. Awareness and introductory level courses in technology education are drawn from the broad overview of the discipline presented in the first two vertical divisions of the chart. The detailed content necessary for exploratory and elective courses in each technological system comes from horizontal views across the last three divisions of the chart.

The chart is also the organizational basis for four supplemental classroom activity books, one for each of the technology systems, that are also available from the Department of Public Instruction. Each activity in the books is keyed to one of the instructional concepts identified on the chart.

TECHNOLOGY EDUCATION CONTENT*

Technology

Communications	1. Graphic	**A. Printing Systems and Processes**	**Relief • Screen • Lithography • Gravure • Electrostatic • Ink Jet**
		B. Photographic Systems and Processes	Film Imaging • Electronic Imaging
		C. Industry Products	**Paper/NonPaper Materials • Consumable/Permanent Uses • Film • Print • Video**
		D. Industry Impacts	Economic • Political • Values/Attitudes • Environment • Aesthetic
	2. Electronic	**A. Telecommunications Systems and Processes**	**Radio • Radar • Television**
		B. Hard-Wired Systems and Processes	Telephone • Telegraph • Public-Address Systems
		C. Computer Systems and Processes	**Analog • Digital**
		D. Industry Products	Entertainment • Information/Data • Detection/Control • Computations • Data Exchange
		E. Industry Impacts	**Economics • Political • Values/Attitudes • Environment**
	3. Light	A. Interactive Systems and Processes	Laser • Fiber Optics
		B. Passive Systems and Processes	**Signs • Flashing Signals**
		C. Industry Products	Entertainment • Information/Data • Detection
		D. Industry Impacts	**Economic • Political • Values/Attitudes • Environment**
	4. Acoustic	A. Sonic Detection Media and Processes	Gas • Liquid • Solid
		B. Storage and Retrieval Systems and Processes	**Phonographs • Tape • Disks**
		C. Industry Products	Information/Data • Detection/Control • Entertainment
		D. Industry Impacts	**Economic • Political • Values/Attitudes • Environment**
Construction	1. Planning Processes	**A. Research and Development**	**Initiating the Project • Developing the Project • Implementing**
		B. Marketing	Analyzing the Market • Establishing Strategy • Promoting • Closing the Sale
		C. Industrial Relations	**Hiring • Training • Providing Benefits • Providing Career Options**
		D. Financing	Appraising Property • Estimating Costs • Funding • Documenting • Budgeting
	2. Production Processes	**A. Preparing the Site**	**Clearing • Setting up Temporary Facilities • Surveying • Earthworking**
		B. Building the Structure	Setting Foundations • Building the Major Structural Elements
		C. Installing Utility Systems	**Installing Permanent Utilities and Mechanical Plant • Providing Temporary Equipment**
		D. Enclosing the Structure (Rough Finishing)	Preparing Materials • Handling Materials and Components • Assembling in Place
		E. Finishing the Structure (Fine Finishing)	**Prep. Subsurfaces • Prep. Materials • Handling Materials • Trimming • Removing Equip. & Debris**
		F. Completing the Site	Removing Temporary Plant and Facilities • Landscaping • Building Features • Shaping the Finishing Earth • Removing Landscaping Equipment and Debris
		G. Servicing the Project	**Diagnosing/Troubleshooting • Repairing • Altering • Installing • Maintaining**
	3. Managerial Processes	A. Planning	Formulating • Researching • Designing • Engineering
		B. Organizing	**Structuring • Supplying • Scheduling • Routing • Storing**
		C. Directing	Coordinating • Assigning • Supervising • Inspecting • Authorizing
		D. Controlling	**Monitoring • Reporting • Correcting**
Manufacturing	1. Input (Planning Factors)	**A. Material**	**Direct • Indirect**
		B. Human Resources	Managerial • Scientific/Technical • Office/Clerical • Worker/Operator
		C. Capital	**Plant • Equipment**
		D. Finance	Debt • Equity
		E. Knowledge	**Technological • Scientific • Humanities • Formal**
		F. Energy	
	2. Production Processes	**A. Extracting**	**Drilling • Harvesting • Mining • Other**
		B. Primary Processes	Thermal • Chemical • Mechanical • Electrical
		C. Secondary Processes	**Casting and Molding • Forming • Separating • Conditioning • Assembling • Finishing**
	3. Managerial Processes	A. Management Functions	Planning • Organizing • Actuating • Controlling
		B. Types of Managed Production	**Custom • Intermittent • Continuous**
		C. Managed Activities	Establishing the Organization • Designing the Product • Preparing to Produce • Producing • Delivering • Serving • Controlling the System
	4. Outputs	**A. Primary Outputs**	**Raw Materials • Industrial Goods • Finished Goods**
		B. Other Outputs	Scrap • Pollution
Transportation	1. Planning Base	**A. Elements of Transportation**	**Human Mobility • Movement of Goods and People • Physical—(Natural and Human Produced)**
		B. Conquest of Time and Space	
		C. Foundation	**Inventions • Innovations**
		D. People Systems	Personalized • Mass Transit
		E. Material and Goods Systems	**Natural Forms of Movement • Technologies of Transport**
		F. Mediums	Land • Water • Air • Interrelated
	2. Transporting Processes	**A. Receiving**	**People (Personalized and Mass Transit) • Materials/Goods (Bulk, Gross, Packaged)**
		B. Holding/Storing	People (Personalized and Mass Transit) • Materials/Goods (Bulk, Gross, Packaged)
		C. Loading	**Manual • Manually-Operated Mechanical • Mechanized • Hybrid**
		D. Moving	Terrestrial (Personalized and Mass Transit, Cargo–Bulk/Unit) • Marine • Atmospheric • Space
		E. Unloading	**Automated/Mechanized • Manual/Mechanized • Manual • Hybrid**
		F. Delivering	Means of Delivering to Final Destination
	3. Technical Systems	**A. Energy Sources**	**Electrical • Chemical • Kinetic • Gravity • Mechanical • Magnetic • Solar • Nuclear**
		B. Energy Conversion	Internal Combustion • External Combustion • Hybrid Systems
		C. Propulsion	**Mech. Drive • Hydraulic Drive • Electric Drive • Vacuum • Gravity • Reaction • Storage Devices**
		D. Suspension	Mechanical • Fluid • Magnetic
		E. Control	**Velocity • Directional • Attitude • Altitude • Vehicular and System Control**
		F. Guidance	Guideways • On-Board and External Devices • Interrelationship of Guidance and Control
		G. Structural	**Vehicular Design Considerations • Guideway Design Considerations • Support System Structures**
		H. Support	Physical Facilities • Personnel • Regulatory Factors • Operational Systems
	4. Environmental Factors	**A. Human/Social**	**Safety • Human Values & Desires • Enhancement of Social, Recreational, Cultural Prog. & Facilities • Comfort/Convenience • Demand Responsiveness • Service for Handicapped & Disabled • Privacy**
		B. Economic/Service	Transportation Costs • Access to Employment Opportunities • Efficiency
		C. Physical/Functional	**Effects on Land Use • Adaptable to Future Needs • Flexibility • Adaptable to Intermode Operation**
		D. Aesthetics	General Appearance • Conservation of Natural Resources
		E. Interrelated	**Noise Level • Pollution Characteristics • Neighborhood Growth and Development • Accessibility**

A poster size (33.5 inch by 21.5 inch) version of this chart comes with the publication when purchased from the original source.

*Based on taxonomies appearing in Thomas Wright and Leonard Sterry (co-directors). *Industry and Technology Education: A Guide for Curriculum Designers, Implementors, and Teachers.* Lansing, IL: The Technical Foundation of America.

Sequences: Program Models

A series of specific course outlines is presented in Section 5 of this guide. What follows here are recommended models of where the courses might be offered in a school setting. The model in Figure 4 is designed for a large program. The model is drawn from the content chart (Figure 3), viewed vertically for the discipline overviews suggested up through Level II, and then horizontally for the specific systems course content of Levels III and IV. *(Levels refer to levels of technological literacy and not to school grade levels or content chart divisions.)* The fifth level, an applications level, is part of the core curriculum and is synthesized from material presented in any of the other levels, as appropriate.

"Combining the enterprise and manufacturing segments together can be a powerful curriculum design that has the potential to help students gain unique experiences, opportunities for responsibility and leadership, and problem-solving expertise."

–Symposium III Proceedings, John R. Wright, 1981

This applications level (Level V) is the level with greatest flexibility in both content and methodology. It is developed on a local school and student-specific basis to meet individual student needs. The school becomes a coordinator of not only "in-house" resources, but other resources in the community to provide individual students, or groups of students with educational experiences. Application of knowledge is the primary purpose. Some of the sample programs that work well at the applications level are described in Section 6, as part of the delivery system for technology education. A form to be used in determining focus, objectives, and methodologies for each student involved in an applications project is included in Appendix D.

Regardless of the program size, Levels I, II, III, and V remain the same for all programs. Adjustments necessary to accommodate program size are made in Level IV. At this level, key concepts from several courses can be combined, thus maintaining breadth, yet allowing schools to deliver a program of manageable size. Typical combining in Level IV, for example, might be to combine planning and management concepts courses, thus reducing Level IV from twelve offerings to eight offerings. However, it is important that *each* system be taught—combining should not overemphasize courses in one system to the detriment of others. Again, a very small program might use only the "core" program—Levels I, II, and III with Level V application programs inserted as appropriate. A core program model is shown in Figure 5.

It is also important to remember that students will make the ultimate decision about how learning will be applied. We can anticipate some of those applications and provide learning opportunities accordingly, but students make the final decision.

. . . students will make the ultimate decision about how learning will be applied.

Some possible ways in which students might use Level V (application-level) learning experiences would include working for someone; self-employment; small-business ownership; advanced technical education; university education; exploring new opportunities; developing new interests; being technologically enlightened; learning mathematics, communica-

Figure 4

Large Program Curriculum Model

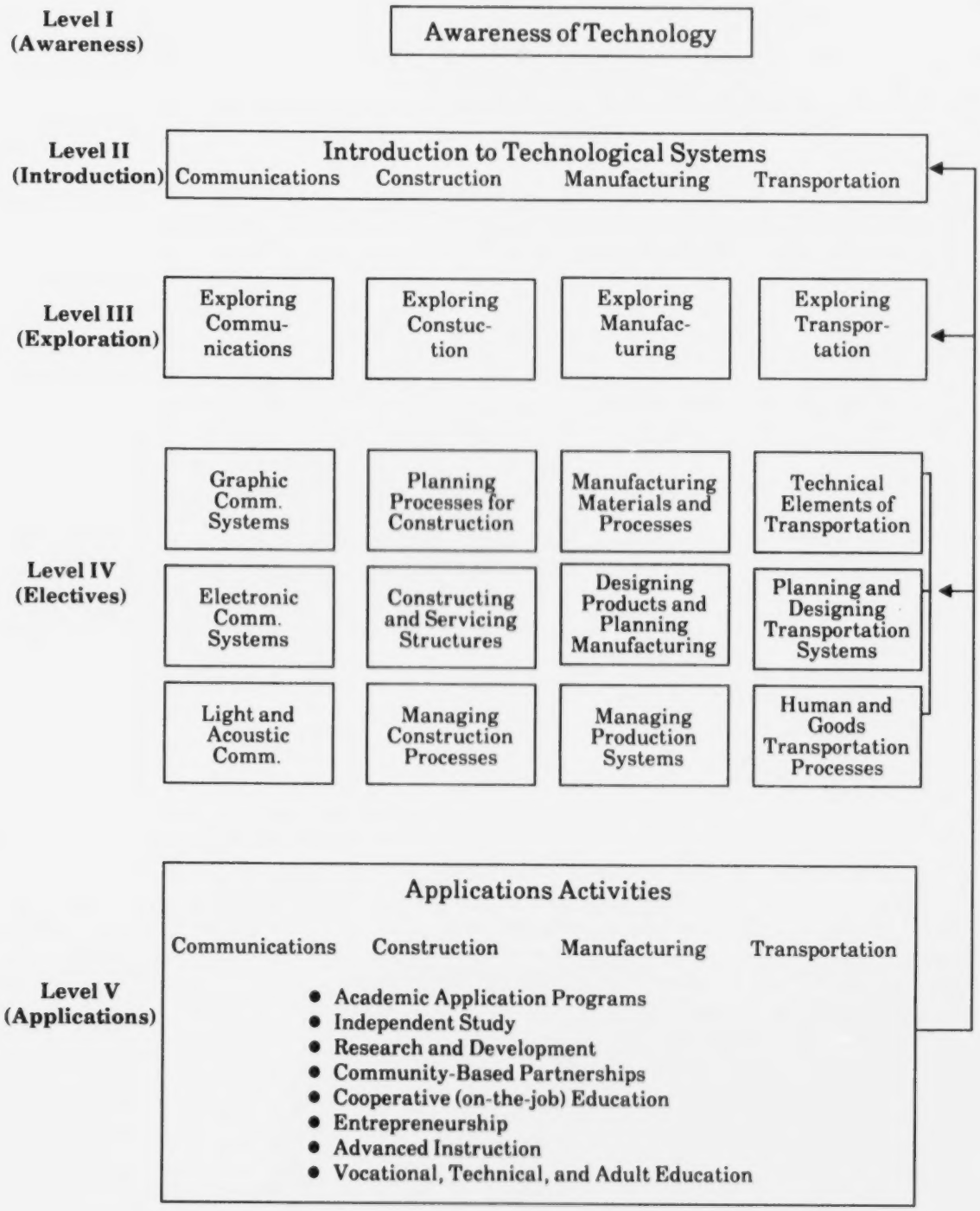
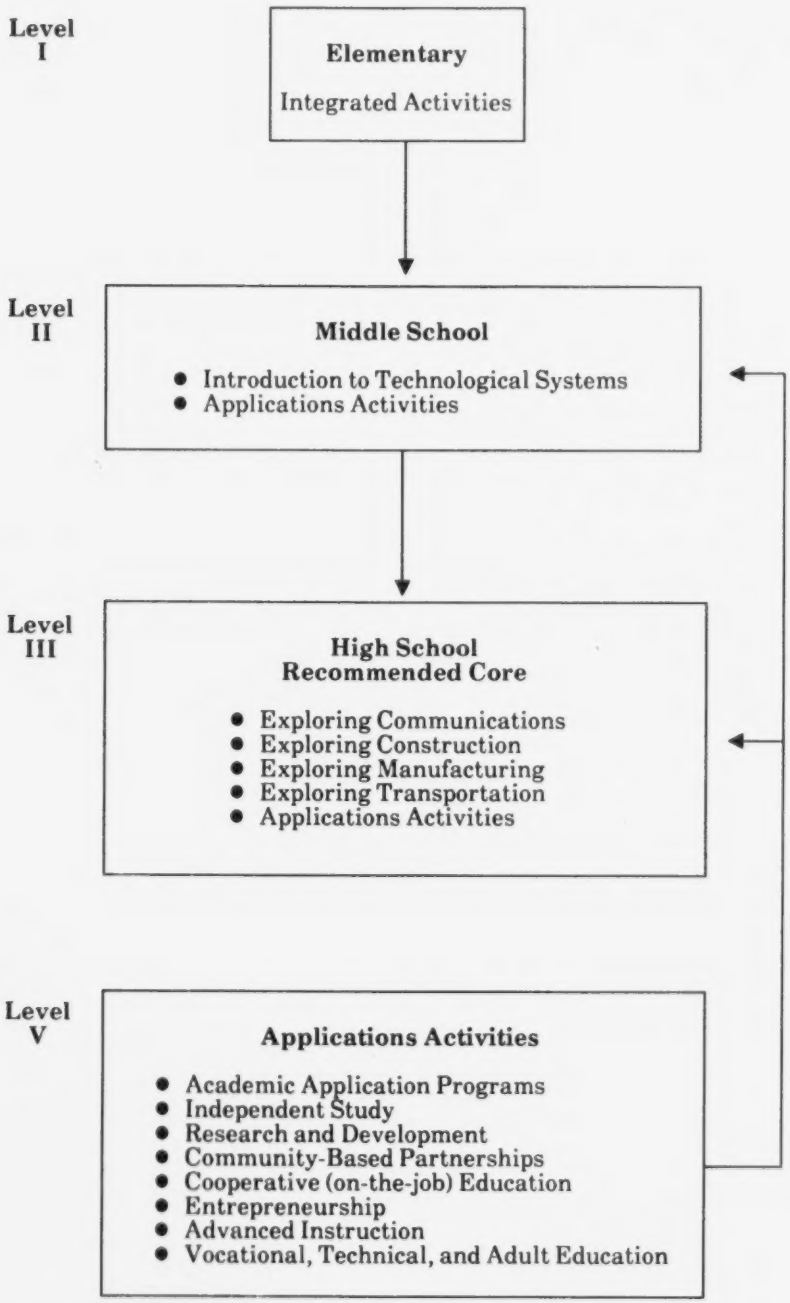


Figure 5

Core Curriculum Model



"We recognize the difference between a hand-made product and its machine-made copy by the mistakes in the hand-made product."
–The Technology Teacher, 1985

tions, and science through application; and being able to solve technical problems.

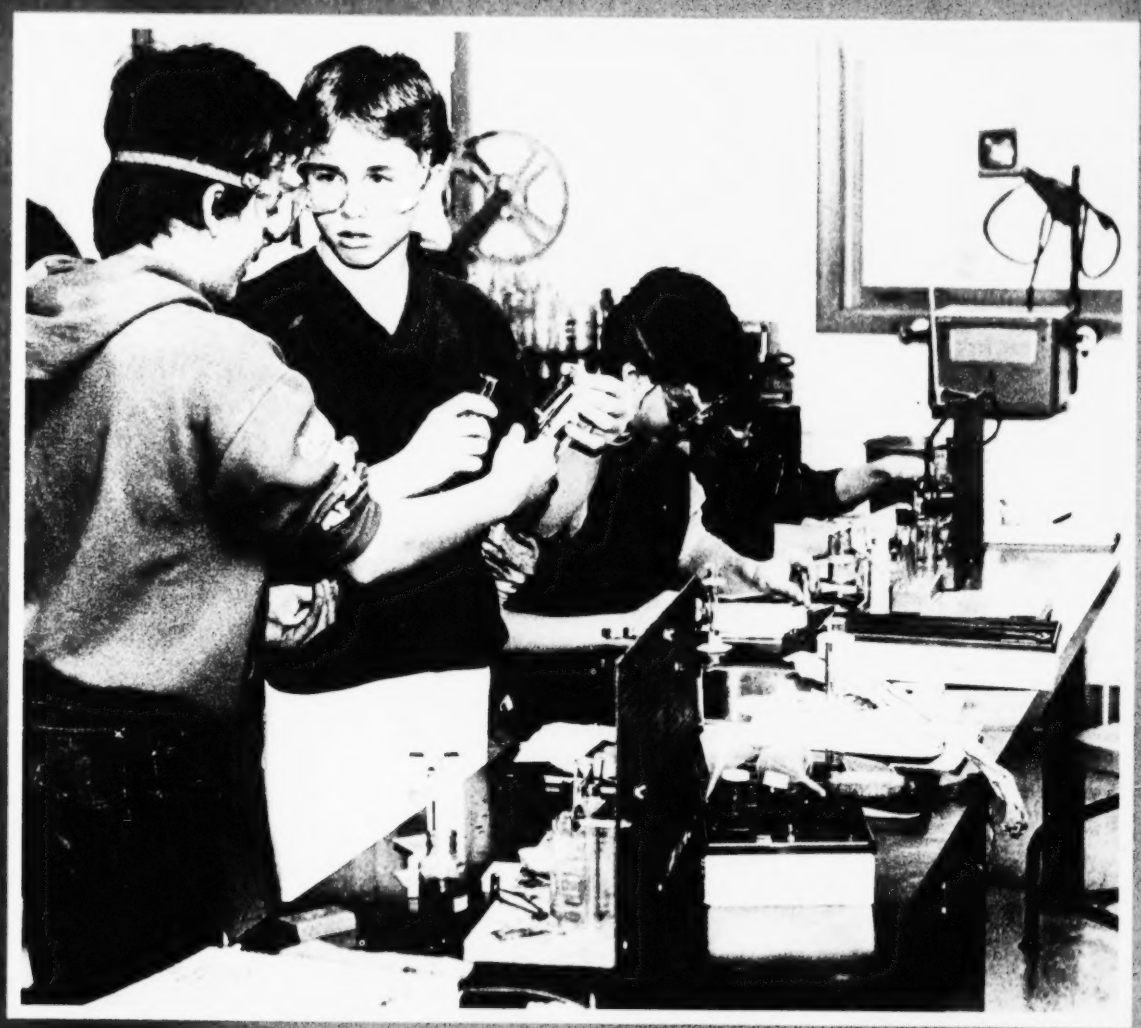
As students make these and other applications, the challenge to curriculum designers is to develop programs to accommodate all these and other applications. Application-level activities must provide students with many options, using versatile methods of instruction along with comprehensive curriculum design. Each activity should be comprehensive and include many student options.

There are some additional thrusts or emphases that can be considered at this upper level. Earlier it was suggested that course content from other domains of knowledge should be integrated whenever possible. Although this is a consideration at all levels, it is an especially important consideration at Level V. The Wisconsin Department of Public Instruction is currently developing modules of instruction for mathematics. These modules are designed to be integrated with concepts of technology. The purpose is to help students learn mathematics through application. A similar set of modules is being developed for applied communications, and another program is available to teach applied science. The latter is "Principles of Technology," designed to be taught as a unit that integrates concepts of physics with technology in a sequence of two applied courses. For further information about these modules, contact the technology education consultants, Department of Public Instruction, 125 S. Webster Street, P.O. Box 7841, Madison, WI 53707-7841.

A Planning Process

2

Introduction
An Eight-Step Process



Introduction

The goal of curriculum development is the improvement of the technology education program through implementing specific changes. Changes may range from complete program revision to individual course revision. They may be implemented in a short time period or continue for several years before implementation is completed. Whatever the magnitude of the change, success depends on the thoroughness of the planning process before implementation begins.

This guide suggests an eight-step planning procedure to pave the way for smooth curriculum changes. The process includes

- initiating the change;
- establishing leadership;
- determining the membership of the planning group;
- identifying available resources;
- evaluating the present program;
- developing the curriculum;
- providing in-service; and
- implementing the curriculum.

An Eight-Step Process

One: Initiating the Change

"All education springs from some image of the future. If the image of the future held by society is grossly inaccurate, its educational system will betray its youth."
–Alvin Toffler, 1974

The need for change is usually present long before it is recognized. The precipitating action may be a comment by a student, a parent, a fellow teacher, or some other member of the community; it may be awareness of declining enrollments, revised standards, or new state and federal mandates; it may be a realization by one or more faculty members that many things are combining to produce a climate for change.

Although realization may occur simultaneously in the minds of several, it is usually the action of one individual that initiates the change. That individual can expect to encounter responses varying from complete agreement to refusal to consider any suggestions. However, if any change is to occur and be accepted by all who will be involved, cooperation is imperative. Those who are to use the developed curriculum must have a sense of ownership, and a realization that they have contributed to the final project.

Ownership cannot be guaranteed by any one or even any group of activities. However, there are techniques that have been effective singly and collectively in helping to develop the attitude that the resulting curriculum included contributions from the participating group members. These techniques include:

- Seek and utilize member contributions.
- Acknowledge the competency of the participants.
- Use consensus decision making.
- Allow time for ideas that may be new or threatening to be internalized.
- Divide the project into a series of manageable smaller tasks.
- Reward and reinforce the efforts of those who participate.
- Provide assurance that time, financial, and/or other administration-controlled resources will be committed and will be adequate to the needs of the project.

Two: Establishing Leadership

Once interest in change occurs, leadership responsibility should be delegated to one person. That person must be accepted by the group, must have leadership and organizational skills, and ideally should be well versed in the curriculum development process. That leader might be a local vocational education coordinator (LVEC), department chairperson, director of curriculum, or some other person who has demonstrated curriculum knowledge and leadership ability.

Three: Determining the Membership of the Planning Group

One of the earliest responsibilities of the designated leader is to establish a group who will participate in the mechanics of developing the curriculum. The membership of the committee should consist of representatives of all groups who will be involved in the implementation or who will be otherwise affected by the materials developed, and others whose interest, cooperation, and expertise will be important to the success of the new curriculum.

. . . diverse membership assures a broad-based curriculum . . .

Potential members should include technology education teachers from all levels, as well as teachers of other disciplines and of special needs students. Counselors, administrators, reading specialists, school board members, and business and industry personnel should also be represented and involved, either as working members or as resource persons. Such diverse membership assures a broad-based curriculum and will promote improved relationships throughout the district through the resulting cooperation and articulation between levels and disciplines.

Four: Identifying Available Resources

A thorough investigation of the many human, material, time, and financial resources available in the local district should be conducted before developmental activities are begun. These resources, once identi-

fied, should be evaluated and classified according to their potential value to the curriculum effort.

"Partnerships bring increased knowledge, access, time, manpower, and financial resources from other sectors in the community."
–Madeleine B. Hemmings, 1984

Human. The most readily available and probably the most valuable of the human resources is the local district faculty and administration. This includes the planning committee, but other persons should not be excluded from consideration. Special needs, mathematics, science, communications, social studies, business education, and home economics teachers may be valuable sources of pertinent information. Involving counselors, administrators, and board of education members as resource persons also provides an opportunity to keep all parties informed of plans and progress. The community outside of the school complex can also provide valuable resources. Business and industry representatives and other interested persons are frequently willing to participate. Consultants from the Wisconsin Department of Public Instruction, technical institutes, and colleges and universities, as well as persons from other public school districts, are also potential contributors. As more human resources are identified, additional persons may be added to the planning committee.

Material. Reams of material resources—curriculums, books, journals—are available for review and/or purchase from the DPI; from professional organizations, such as the International Technology Education Association (ITEA) and the Wisconsin Technology Education Association (WTEA); from state and federal agencies; and from other districts. Addresses of some of these agencies/organizations are given in the Resources and References section of this guide.

One of the most important resources is a timeline that outlines the sequence of events . . .

Time. One of the most important resources is a timeline that outlines the sequence of events and the estimated time required. It should be developed early in the planning stage. Time for visitations, workshops, meetings, and other inservice activities needs to be scheduled in addition to the time needed for actually writing the curriculum.

A completed five-year timeline and a monthly planning worksheet for it have been included as sample tools (Figures 6 and 7). Note the timeline activities scheduled for October. Examine also the planning worksheet and also note how the objectives written on the worksheet can be based on the overall timeline for curriculum revision.

Financial. Finally, no curriculum planning effort can proceed very long without a financial commitment from the local board of education. Here is one area especially where early, on-going contacts with the participants can pay real dividends later. Money must be budgeted, and guidelines for spending it must be developed. Outside sources of funding—grants from business, industry, and state and federal agencies, for example—should be investigated so proposals can be written, as necessary.

Figure 6

Sample Timeline for Introducing Curriculum Change

Year 1
(Awareness)

- Awareness of Technology

Year 2
(Introduction)

- Introduction to Technological Systems
- Applications Activities

Year 3
(Exploration)

- Exploring Communications
- Exploring Construction
- Exploring Manufacturing
- Exploring Transportation
- Applications Activities

Year 4
(Electives/Applications)

- Graphic Communications Systems
- Electronic Communications Systems
- Planning Processes for Construction
- Constructing and Servicing Structures
- Manufacturing Materials and Processes
- Technical Elements of Transportation
- Human and Goods Transportation Processes

Year 5
(Electives/Applications)

- Research and Development
- Independent Study
- Entrepreneurship
- Community-Based Partnerships
- Cooperative Programs

Monthly Plan for Each Year

September. Make advisory committee aware of possible program changes.

October. Review philosophy of technology education and suggest changes to address the systems approach to technology education. Use DPI and other consultants. Review the technology education curriculum planning guide for recommendations on course development strategies.

November. Set up an ad hoc committee representing a variety of personnel. Establish a phase-in plan wherein each course level is identified for development. Salvage those units of instruction from present course(s) that fit the philosophy, goals, and objectives of a technology education course.

December. Identify course description, goals, and objectives for the program level being developed.

January. Collect instructional materials and resouces as you build instructional units for each program level.

February. Construct a course outline with instructional units to be taught. Evaluate tools and equipment on hand and prepare recommendations for additional equipment to cover all units of instruction.

March. Determine other resources and instructional materials necessary to teach each unit in the outline. Prepare curriculum project for vocational education funding to supplement part of the cost of implementation.

April-May. Seek approval of course outline from the

- technology education department,
- advisory committee,
- curriculum committee, and
- board of education.

June. Prepare units of instruction, handouts, tests, worksheets, and other materials during summer in preparation for teaching in the fall when school begins.

July-August. Order equipment to carry out instruction.

Figure 7

Sample Monthly Planning Worksheet

Objectives to Address	Person Responsible	Completed by				
		Year 1	Year 2	Year 3	Year 4	Year 5
Review the program philosophy, mission, and/or rationale for change to technology education from a traditional industrial education program. • Staff involvement in summer • DPI and other consultants • Review sample programs	• Principal • LVEC • Department chair-person • Consultants	Oct.				

Five: Evaluating the Present Program

To change the existing curriculum does not necessarily lead to discarding all of the current program. It may be impractical, financially impossible, or just undesirable to implement a completely different program. To determine what parts of an existing program are functioning and satisfactorily meeting needs, an evaluation may be essential. Many systems of self-evaluation can help to establish values, direction, and priorities. The Wisconsin Department of Public Instruction, in cooperation with the University of Wisconsin-Stout, sponsors a vocational education evaluation, which utilizes teachers and administrators from other school districts. The model for this evaluation process is discussed in detail in the next section. The findings, solutions, and recommendations from such an evaluation, or from other systems of evaluation, can be helpful in identifying a need for change and a process for improvement.

To change the existing curriculum does not necessarily lead to discarding all of the current program.

Six: Developing the Curriculum

The DPI defines "curriculum" as "a particular course of study; all such courses of study, collectively; the content of a subject area and how it is organized."* In devising guides for curriculum development, the department includes as common elements

- a philosophy or rationale for the educational program;
- goals and objectives for each learning level;
- sequences of learning, both within and among grade levels;
- instructional strategies for meeting goals and objectives;
- instructional activities designed to meet the needs of students with varying abilities and needs; and
- a variety of methods for evaluating progress toward learning objectives.

The list of elements is arranged in recommended order for curriculum development. Following this order should give the local planning group a concise framework for adopting and/or revising their specific, local technology education curriculum. *Locally, the rationale—a statement including an explanation of need and mission—must be the consensus of the curriculum committee, accepted by all members before the development can proceed.* The goals and objectives must agree with those of the district, be based on the program rationale, and again should be the consensus of all participating members. Content developed for all courses must be related to the program goals and objectives.

The importance of completing the rationale, goals, and objectives before continuing through the other necessary elements cannot be overemphasized. Agreement there, on the broad framework of the technology education curriculum, will facilitate later discussions of sequences and specific instructional strategies. Actual, detailed course outlines and lesson plans will flow naturally then from the consensual objectives.

The importance of completing the rationale, goals, and objectives before continuing through the other necessary elements cannot be overemphasized.

*Wisconsin Department of Public Instruction, *A Guide to Curriculum Planning* (Madison, WI: Department of Public Instruction, 1985), p. ix.

Seven: Providing Inservice

The staff members who are to develop the curriculum and those who are to implement it may need opportunities to learn new content, strategies, and procedures . . .

Developing curriculum is an important educational experience. Skills needed for the development are not necessarily found in all staff persons, nor is the time needed available to all persons. It is important that this be recognized and appropriate steps be taken to assure that the completed curriculum is a quality document.

The staff members who are to develop the curriculum and those who are to implement it may need opportunities to learn new content, strategies, and procedures from each other and from others in the field. Inservice meetings should be conducted throughout the year to provide information and skills to complement the implementation of a technology education curriculum.

Externally, also, timely and relevant information is readily available to shed light on specific aspects of curriculum development, whether on method or content. Attendance should be encouraged at any of the following recurring activities, which are especially helpful and accessible for Wisconsin educators.

- **February, March**
  - WTEA High Tech Weekends (Wisconsin Technology Education Association)
- **March**
  - ITEA Convention (International Technology Education Association)
  - University of Wisconsin-Platteville Spring Seminar
- **April**
  - DPI's VICA Skill Olympics (Vocational Industrial Clubs of America)
  - WVA Conference (Wisconsin Vocational Association)
- **July, August**
  - DPI's Technology Teacher Workshops
- **August**
  - DPI's Vocational Education Conference
- **October**
  - University of Wisconsin-Stout Technology Education Conference
  - WTEA Technology Teacher Convention
- **November**
  - DPI's VICA Leadership Labs
- **December**
  - AVA Conference (American Vocational Association)

Other conferences and seminars are held by cooperative educational service agencies (CESAs), university groups, and the DPI as needs arise. Additional information can be acquired by communicating directly with the sponsor listed. Association addresses are listed in the Resources and References section of this guide.

Eight: Implementing the Curriculum

The blueprint for implementing a new or revised technology education curriculum is the five-year (or other) timeline developed early by the planning committee. If it has been carefully conceived, it spells out the implementation steps. They should follow the timeline with special attention to the recommended sequence. The timeline is the best summary of the time and resources needed for completion of the overall plan.

Even so, however, it should be viewed as an estimate. Flexibility in planning extends to all procedures in curriculum development and especially to the timeline. Developing technology education curriculum takes time. Almost all units of instruction must be developed from varied resources. No single textbook is available for each technical system. Some time is necessary to field test the new curriculum and additional time to revise. It takes a lot of commitment to make the change from industrial education to technology education.

It should also be noted that implementation of a new technology education curriculum does not terminate the action of the planning committee. Monitoring, evaluating, and modifying the curriculum is a continuing effort if the new program is to be a success.

"People resist change even while they welcome it. Every society honors its live conformist and dead troublemakers."
–Symposium VI Proceedings, Kendall Starkweather, 1984

Influences on Curriculum

3

Introduction
Local Philosophy
State and Federal Directives
Program Evaluation
Other Influences

Introduction

"If you discovered a new planet that was dominated by high technology, would you propose traditional industrial arts for its youth?" –The Technology Teacher, Donald P. Lauda, 1984

As noted earlier, change is the driving force of curriculum development, and it comes in many forms. New federal, state, or local requirements often precipitate curriculum revision. As new computer-aided, interactive video instruction, or other innovative educational methods become widespread, curriculum development must be undertaken to incorporate these into a program. Again, as society confronts sexual, cultural, and other equity barriers, curriculum must also change to reflect new standards. Also, as the content base changes as, say, industrial education gives way to technology education, curriculum efforts must be undertaken to reflect the new directions of the discipline. Curriculum development is the act of acknowledging and incorporating change in a purposeful manner.

Curriculum is one of the crucial areas every teacher must know because it is concerned with what students will learn as a consequence of what they do in the learning situation. The curriculum development process blends the agendas of the government, community, district, school, program/course, and teacher, and transforms them into meaningful content, activities, and learning for students. The resulting "curriculum" is meaningful content that makes a difference in the classroom.

This chapter will highlight influences on curriculum that must be considered as schools and staff specifically develop technology education courses. A more detailed presentation of the general curriculum development process is found in *A Guide to Curriculum Development* (Madison, WI: Department of Public Instruction, 1986).

Local Philosophy

Curriculum can be viewed as the sum of learning activities and experiences that a student encounters in school.

Curriculum can be viewed as the sum of learning activities and experiences that a student encounters in school. A strong rationale and philosophy provide a baseline from which decisions can be made. Goals and objectives of the district provide program direction and meaning to curriculum within the whole school. Program objectives are more specific and focus on what students are to learn. Curriculum development is a process that takes all these into consideration as it is undertaken and implemented by each teacher.

All districts and programs should have a rationale for existing. Why does yours exist? Why is it needed in your town or community? How does it contribute to society? Every school needs a rationale for being, which should be reevaluated periodically. The rationale serves as the underpinning of the philosophy.

From the rationale comes the district's philosophy. Philosophy deals with beliefs and values. It is the value system underlying educational planning, the rationale upon which actions are based. Does the district value individual self-worth? Does it value enrichment activities and serv-

ice to special populations? Does it believe that children should come away from their education with some basic or general knowledge? What about vocational/job readiness skills? Does the district believe that every student should have the opportunity to explore alternative learning styles.

A district philosophy... provides a frame of reference from which to review or develop curriculums.

The philosophy of the district determines if technology education will be part of the curriculum. A district philosophy states the district's general beliefs, concepts, attitudes, and values regarding education and provides a frame of reference from which to review or develop curriculums. If, for example, a district believes that students must be prepared for the world of work, then what implications does that hold for the technology education program and teacher?

Goals and objectives provide more specific direction for what happens in schools. Goals are statements of general purpose or intent and are derived from the prevailing educational philosophy. School and district goals should also reflect statewide goals and provide a basis for developing more specific program, department, and course goals. A districtwide goal may be to provide academic skills to all students, or it can be more specific like providing access to special populations. A goal may be an ideal you hope to achieve, whereas an objective defines how you go about achieving the goal. In fact, you may have several objectives to achieve a single goal.

Assume your district's rationale for having schools is that they provide knowledge and skills to students, who will in turn make a contribution to the community. Part of the district's philosophy, then, is a belief that students can learn knowledge and skills in schools. The school's or department's goal may be to expose students to as many opportunities as possible to develop skills and knowledge which will make them contributing members of the community. From this, an implementing objective may be to offer a K-12 technology education program so students can learn the basic skills that will transfer from job to job. Another objective may be to offer a technology application course in high school so students can be placed in a job upon graduation.

State and Federal Directives

... curriculum is influenced at a number of levels from the classroom to the congress.

Of course, curriculum is influenced at a number of levels from the classroom to the congress. At the classroom level, specific curricular tasks include teacher lesson plans; cognitive, affective, and psychomotor learning objectives; and determining instructional scope and sequence of course content. Larger schools typically have curriculum committees to address scope and sequence of program areas (which communication class should be taught in what grade), program continuity, and articulation with junior high or vocational, technical, and adult education (VTAE) programs. Curriculum tasks at the school level might include coordination among and between programs, staffing, inservice activities; and schoolwide committee work. District level concerns include vertical articulation among school levels, resource allocation, and work with community and school boards. State level tasks might include coordination of educational institutions; materials and guides development; special interest group work; and legislative and legal activities. Finally, national level curriculum tasks include work with congressional committees; legal court actions;

interaction with associations and national education societies; and the implementation of federal priorities. The result of efforts going on at all these levels may be some very specific directives about curriculum.

State Standards

Within the state, curriculum development should begin with a review of Wisconsin statutes that affect curriculum. They contain various specific directives that affect technology education.

. . . curriculum development should begin with a review of Wisconsin statutes that affect curriculum.

118.01 Educational goals and expectations. (2)(b) *Vocational skills.* Each school board shall provide an instructional program designed to give pupils:

1. An understanding of the range and nature of available occupations and the required skills and abilities.
2. Preparation to compete for entry level jobs not requiring postsecondary school education.
3. Preparation to enter job-specific vocational training programs.
4. Positive work attitudes and habits.

121.02 School district standards. (1) Each school board shall:

(i) Provide safe and healthful facilities.

(k) Develop a written, sequential curriculum plan that includes language arts, mathematics, social studies, science, health, computer literacy, environmental education, vocational education, physical education, art and music. The plan shall specify objectives, course content and resources and shall include a program evaluation method.

(L)2. In grades 5 to 8, provide regular instruction in language arts, social studies, mathematics, science, health, physical education, art and music. The school board shall also provide pupils with an introduction to career exploration and planning.

(L)3. In grades 9 to 12, provide access to an educational program that enables pupils each year to study English, social studies, mathematics, science, vocational education, foreign language, physical education, art and music. In this subdivision, "access" means an opportunity to study through school district course offerings, independent study, cooperative educational service agencies or cooperative arrangements between school boards and postsecondary educational institutions.

(m) Provide access to an education for employment program that has been approved by the state superintendent.

Education for Employment Initiative

In concert with these statutory directives, the Department of Public Instruction has recently responded to concerns about student preparation for the world of work by adopting the Education for Employment initia-

tive, which requires the development of local or regional business and education partnership councils. The state superintendent called for a plan from each district showing how Wisconsin's public schools could better prepare students for the future work world, whether they directly enter the work force or first obtain university or other postsecondary vocational education.

Seven essential elements of such plans have been identified. These too must be considered in the development of technology education curriculums.

- School supervised work experience
- Business and education partnerships
- Practical application of basic skills
- Career education, planning, and guidance
- Employability skills and attitudes
- Business operations and economics
- Contemporary vocational education programs

"We must also recognize that our vocational classrooms are just as important as any other. And we should insist that the vocational courses we teach prepare this generation with the skills they need for real jobs."

–Ronald W. Reagan

Wisconsin Developmental Guidance Model

The Wisconsin Developmental Guidance Model is a specific, preventive program based on the belief that all children in school should participate in activities and instruction that will meet their optimal personal/social, career/vocational, and learning development needs as they progress through school. This is a state response to the national need to provide students with the right kinds of guidance information based on their development. As they develop curriculum, it is essential that all technology education teachers know of this model in order to work with school counselors and other guidance personnel. Specific kinds of career and vocational competencies are spelled out in this model, which technology education programs can address. A detailed explanation of the model is available in *School Counseling Programs: A Resource and Planning Guide* (Madison, WI: Department of Public Instruction, 1986).

Federal Changes

Federal changes in rules and regulations concerning schools and special populations also directly affect technology education curriculum...

Federal changes in rules and regulations concerning schools and special populations also directly affect technology education curriculum development. For example, Public Law 192, which was enacted in 1975, had wide applications for handicapped students in industrial arts/technology education programs. The Carl Perkins Vocational Education Act of 1984 requires that a full range of vocational education programs be accessible to all handicapped and disadvantaged students. Then, too, laws at the federal level addressing sex equity by increasing educational opportunities and eliminating discrimination have been enacted, and they also affect curriculum. During the process of curriculum development, consultation with professionals who are familiar with these federal rules should be sought. The changes required are so important that this subject has been given expanded, detailed treatment in Appendix A. The changes are reflected in state directives.

An ideal time for more careful consideration of these equity and special needs issues is when curriculum is being considered for revision. Local boards are required to develop policies prohibiting discrimination

against pupils, extending to admission, to courses or activities, standards for behavior, discipline, administration of private gifts or services, materials selection, testing and counseling, facilities, opportunities for athletic participation, and food service programs (PI 9.03, Wis. Admin. Code). Positive action is required under this provision, not just response, so technology educators should plan to integrate equity-related concepts and skills into the revised curriculum at each stage of development. The revision strategy may involve four stages of incorporation.

Positive action is required under this provision, not just response . . .

The first stage involves complying with the letter of nondiscrimination laws. Changing admission requirements or reviewing counselor practices may have to be explored, for example. The second stage deals with neutralizing stereotypes and bias. It includes reviewing instructional methods and materials for language, activity, or traditional bias.

In stage three, educators need to revise existing curriculum to attract all students and to meet the needs of male, female, and special needs students. Traditional technology education students have been male. Consider what can be done during curriculum revision to seek out and meet the needs of female students, for example.

The last stage is reconstructing the curriculum to develop new knowledge and skills based on changing roles, responsibilities, and conditions. This step requires a shift in the way most technology educators think about the role of women in the traditional male-dominated field, with resulting implications for the curriculum.

. . . educators need to revise existing curriculum to attract all students and to meet the needs of male, female, and special needs students.

With the enactment of the "Education for All Handicapped Children Act" (Public Law 94-142), has come an especial awareness of the need for greater participation of disadvantaged and handicapped learners in technology education classes. As curriculum is being considered, involvement of a special needs assessment team is important in order to consider possible adaptation of instructional methods and materials, equipment, and facilities to accommodate special needs students. Careful thought must be directed toward the possible adoption of curriculum focusing on visible employment outcomes. The DPI is providing support between vocational educators and special education with the designated vocational instruction (DVI) approach. This approach brings together a team of professionals to address special needs students in the technology education classroom. Additional DVI information may be obtained by contacting the DPI.

Program Evaluation

Evaluation should be both a short-term and a continual process. Typical informal sources of information about program effectiveness are student evaluations, peer evaluations, instructor self-evaluation, administrative review, and advisory committees. This type of input can generally be reviewed and appropriate program changes can be made in a short period of time. However, a formal, periodic assessment and a clearly planned improvement process are also critical to efforts to consistently meet student needs for a sound technology education program.

In short, both regular and continual evaluation by local teachers and supervisors, along with periodic review by outside evaluators, are needed to provide schools with information to be used in planning and implementing change to meet the evolving needs in technology education. Evaluation is both the opening and closing step in the continuing cycle of program improvement.

Evaluation is both the opening and closing step in the continuing cycle of program improvement.

Local, Continual Evaluation

The heart of any good evaluation is the evaluation criteria. For example, the following ten statements, which contain criteria for excellent programs, can provide the base for local evaluations. These are taken from *Standards for Technology Education.**

Program Philosophy. A current, comprehensive, and written philosophy serves as a foundation and framework for all elements of the program. It should reflect local, state, and national concerns. The philosophy should influence thought and action for technology education.

Instructional Program. The instructional program should reflect the school and program philosophy. It should provide a wide variety of organized experiences for all students to assist learners in reaching both program and personal goals. The program should also use the four contemporary system organizers (communications, construction, manufacturing, and transportation).

Student Population Served. All students, regardless of their sex, race, creed, national origin, or special needs should be encouraged to enroll in the technology education program. Individual differences in students should be recognized, and all students should be served. Materials used should be reviewed for stereotyping and bias.

Instructional Staff. The instructional staff should be professional and technically competent since staff members provide the essential components of a quality technology education program. Staff members should be involved with professional organizations and should continually strive to remain current in their field.

Administration and Supervision. Administrators and supervisors should provide management and direction for school programs. These personnel perform leadership functions that ensure attainment of technology education program goals and assure a well-managed and comprehensive technology education program with adequate resources to be effective.

"Even if you're on the right track, you'll get run over if you just sit there."

–Mark Twain

Support Systems. The support systems include the human, physical, and financial resources that are necessary to implement the instructional program. They include a media resource center and director, guidance staff, custodial and maintenance staff, clerical help, and medical personnel. An adequate budget with provisions for vocational student organiza-

*Wisconsin Department of Public Instruction, *Standards for Technology Education* (Madison, WI: Department of Public Instruction, 1983).

tion activities, classroom books and materials, maintenance, and new equipment should be available to the staff. The room should be clean and well lit, have sufficient storage space, meet local and state codes, and be large enough to serve the students enrolled.

Instructional Strategies. Strategies for the delivery of technology education must be varied, meeting the needs of all students. The technology teacher should plan, implement, and evaluate these strategies.

Public Relations. An informed and involved public is essential to the promotion of technology education. Various media should be employed to inform students, parents, other educators, business and industry, and government about the local technology education program and to encourage their involvement.

Safety and Health. A comprehensive, written, safety and health program is essential to a quality technology education program. The program should provide for a safe environment and promote lifelong attitudes and practices regarding safety and health, as well as prevent injury during a student's school experience.

Evaluation Process. The nature and frequency of evaluation should be a matter of record in the school. A process for the implementation of improvements found to be needed through evaluation should reflect systematic efforts to upgrade the technology education program.

Each of these standards can be applied relative to planning, implementing, and evaluating the technology education program. An expanded version of these standards can be found in Appendix C of this guide. It includes the standards and their component items, a "Program Evaluation Summary," and a "Deficiency Correction Report." These forms can be used in conjunction with the standards themselves in a program evaluation effort. These standards for Wisconsin programs are consistent with those endorsed by the International Technology Education Association.

Once every three to five years, a periodic, in-depth evaluation is essential to set and review program goals, validate objectives, or produce rationale and momentum for significant departures from current practice.

External, Periodic Evaluation

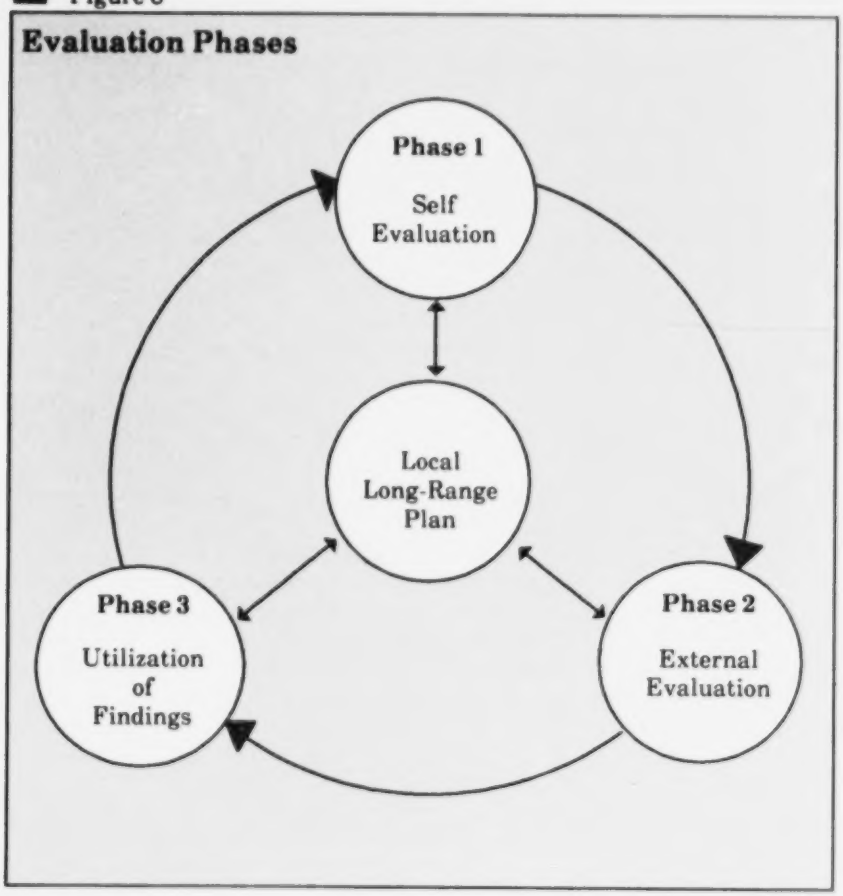
Once every three to five years, a periodic, in-depth evaluation is essential to set and review program goals, validate objectives, or produce rationale and momentum for significant departures from current practice. This process involves the compilation and interpretation of significant data, and an extensive on-site visit by an outside team of investigators.

The Wisconsin Department of Public Instruction's Secondary Vocational Program Evaluation, conducted in each federally funded school district every five years as part of the eligibility requirements for federal vocational money, is one such evaluation. Its purpose is to identify the strengths and weaknesses of a local program, and to make major recommendations for local program improvement. The information gathered and reviewed comes from both written material and interviews with the program staff, school administration, advisory committee, current and past student participants, employers of program graduates, local teachers of other programs, parents, and community leaders. The program profile

that results provides a blueprint for improvement over the next three to five years.

The program evaluation recommended in this guide uses the DPI's secondary vocational program evaluation project. If it is followed, then curriculum development could be based on the three phases of the evaluation model—self-evaluation, external evaluation, and the utilization of evaluation findings. Figure 8 graphically depicts the interaction between these phases and long-range curriculum planning.

Figure 8



The self-evaluation phase requires the technology education department and individual instructors to look at their programs using procedures and instruments from the *Self-Evaluation Manual*.* The results from this self-evaluation can indicate needed curriculum changes based on existing standards for technology education.

*Wisconsin Department of Public Instruction, *Secondary Vocational Program Evaluation Project: Self-Evaluation Manual* (Madison, WI: Department of Public Instruction, 1985).

Team recommendations may include changes in curriculum, scheduling, equipment, and/or staff.

The external evaluation is conducted by a team of professionals using procedures and instrumentations in the *Team Visitation Guidelines.** Feedback from the external evaluation team frequently is given to school administrators, department chairs, and individual instructors. This feedback serves as a basis for curriculum revision and for changes in program implementation.

In the last phase of this evaluation model, the schools, departments, and individual instructors analyze and interpret the findings from the team reports. Team recommendations may include changes in curriculum, scheduling, equipment, and/or staff. Local districts must review the recommendations and make plans for change. Implementation priorities are then set, timelines for changes are established, and methods of monitoring are documented.

Other Influences

Needs Assessment/Labor Market Analysis

"A major purpose of industrial arts/ technology education is to assist students in exploring and selecting occupations relevant to the industrial/ technological society."
–The Technology Teacher, Perry R. Gemmill, 1984

Needs assessment is a process of determining the things that are necessary or useful for the fulfillment of curriculum goals and objectives. In technology education, it can help determine what needs exist and how the needs should be addressed. An integral part of our needs assessment is labor market analysis, which is especially appropriate when education for employment is a goal.

Labor market analysis focuses upon variables from the world of work, including occupational options, job information, and geographic, economic, and social conditions. Labor market information is information about the market where labor occurs; where labor skills are exchanged for wages. Key elements in the labor market are the workers (labor resources) and jobs (employment opportunities). Such information may be tied to a specific geographical area or may describe the labor supply and demand at the state or national levels. The following types of information are often found in labor market analyses:

- occupational descriptions;
- wages, hours, and fringe benefits;
- employment trends and outlook;
- qualifications;
- advancement;
- future impact of technology; and
- occupational characteristics.

Efforts should be made to develop technology education programs/ courses that consider these kinds of information, both locally and in a larger geographic context, such as the region, state, or nation.

*Wisconsin Department of Public Instruction, *Team Visitation Guidelines* (Madison, WI: Department of Public Instruction, 1986).

Technological Literacy

Technological literacy stems from a comprehensive educational process designed to develop a population that is knowledgeable about technology, its evolution, systems, techniques, utilization in industry and other fields, and social and cultural significance. The technologically literate student has been exposed to a set of concepts, processes, and systems that is uniquely technological and has fundamental knowledge about the development of technology and its effects on people, the environment, and culture. Instructional content is drawn from courses built around the four major technological systems.

"Democracy requires a people capable of making decisions. . . and capable of solving problems."
–Don Maley

- Communications—efficiently using resources to transfer information to extend human potential
- Construction—efficiently using resources to build structures on a site
- Manufacturing—efficiently using resources to extract and convert raw or recycled materials into industrial and consumer goods
- Transportation—efficiently using resources to obtain time and place utility and to attain and maintain direct physical contact and exchange among individuals and societal units through the movement of materials, goods, and people

Technologically literate students will contribute significantly to making our world a better place in which to live.

Advisory Committees

Ongoing advisory committees can play an important part in developing curriculum. They are required in vocational programs and should be utilized to provide direction or advice to your program based on existing business/industry job needs. They have content expertise and can propose curriculum changes or they can be used as a sounding board to validate suggested changes by others.

Ongoing advisory committees can play an important part in developing curriculum.

An advisory committee is a group of individuals, usually selected from outside the educational profession, who are chosen from the community to advise the state and school districts regarding technology education programs. It is strictly advisory in its capacity and has no administrative authority.

State Superintendent's Committee

The DPI depends heavily upon input and evaluation from the state superintendent's Technology Education Advisory Committee. The committee provides the valuable perspective of business and industry with regard to curriculum, safety, promotion, and Vocational Industrial Clubs of America (VICA). The efforts of the committee assure that programs from DPI are relevant to the work world, are forward thinking, and utilize the resources of the private sector as appropriate.

The committee meets three to five times a year. It is composed of representatives of industries in all four technology systems, of VICA, and of higher education. The committee is appointed by the state superintendent, and is drawn from throughout the state. Special projects of the committee include developing a model for business-industry partnerships, developing a brochure to promote technology education, and validating the new curricular direction and related publications.

Local Committees

At the local level, the advisory nature of the duties of the committee are similar, but teachers generally recommend interested individuals for appointment by the superintendent or board of education. Local committees should include representatives of education, government, and relevant local industries, and should include both management and union personnel and independent business and trades people.

Criteria for Membership

Advisory committees should have between five and twelve members. Careful procedures should be established to select appropriate and qualified members to serve on the committees.

Experience. Members should have had successful firsthand experience in the specialized area being served. They should be persons who have the respect and confidence of their associates. Technology education advisory committees should have approximately equal representation of those with expertise in each of the four system areas of communications, construction, manufacturing, and transportation.

Adequate Time. Since an advisory committee may meet frequently when necessary, members must maintain close contact with the activities of the school. They should expect to devote time to committee work. It may be advisable to provide alternatives for each member.

Character. Members are invited to serve on an advisory committee at the recommendation of their colleagues. They should have a strong sense of responsibility and be civic-minded.

Duties

The following services can typically be performed by the committee:

Evaluate Curriculum. Does the curriculum relate well to society and the "real" world of work? Is the curriculum relevant from a technical standpoint?

Serve as Educational Resources. Members can provide program appraisals, identify needs, and suggest solutions. They may be able to provide speakers, materials, and occupational information.

Serve as Community Liaison. Members can facilitate two-way communication between the school and the community (public relations).

Provide Leadership. Members can often assist with solving school-related problems at the local level.

Provide Expertise. Council members can serve as judges or coaches for student activities (classroom or VICA, for example).

Provide Information. They can help identify potential co-op sites, for example, or help identify needed facility and equipment improvements.

Members might also be able to write equipment specifications and make purchase recommendations.

Meeting Procedures

Having a specific, consistent format for advisory committee meetings will help keep the committee vital and enthused about their role in the technology education program.

- Inform members of meetings three to six weeks in advance. Provide an agenda with the meeting announcement.
- Three to five meetings a year would be typical and generally adequate. Members do not need to meet just for appearances; make every effort to have significant business before you schedule a meeting.
- Arrange for refreshments.
- Call members a day or two before the meeting and remind them of the meeting.
- Start and adjourn on time.
- Exercise good meeting procedures. Consult *Robert's Rules of Order* and follow the simplified rules for conducting business meetings.
- Follow-up within a week with minutes mailed to all members, school administration, and other interested parties.

Members do not need to meet just for appearances; make every effort to have significant business . . .

Recognition of Members

It is important to recognize and show appreciation to committee members. They make a sizeable commitment of time and energy on behalf of your program. A few ways to accomplish this are listed here, but you may be able to think of others. It is almost impossible to say, "thank you," too often.

- Schedule an appreciation dinner for committee members, administrative personnel, and faculty.
- Send a letter of appreciation.
- Release notices of appointment to local newspapers or professional publications. Be certain to send copies of any resulting publicity to all the members.
- Present certificates of appreciation at a public meeting.
- Invite committee members to events such as VICA competitions, conferences, and professional teacher association meetings.
- Arrange for interviews with local media.

Curriculum Development

Introduction
Identify General Concepts (Organizers)
Determine Scope and Sequence
Provide Upper-Level Flexibility
Design New Courses

Introduction

Curriculum development is a process common to all disciplines. While it must be adapted for each subject area, there are some general guidelines that are relevant for all areas. While focusing on the general *process* of curriculum development, this section suggests ways to tailor that process to provide an effective structure for change in the technology education program.

Identify General Concepts (Organizers)

. . . identify content concepts as early as possible.

In the process of developing a curriculum, it is helpful to think about how that curriculum relates to concepts to be learned. Identifying these will suggest how specific courses might be developed that will express the new curricular directions. In this field, concepts help identify the relationships between technology, society, general education, and work. They provide organizing structure for the discipline. Equally important, concepts are common and transfer readily to new learning situations. It is especially critical to identify content concepts as early as possible. This guide, for example, accepts a simplified form of the technology education taxonomies from the Technical Foundation of America's publication *Industry and Technology Education: A Guide for Curriculum Designers, Implementors, and Teachers* (Lansing, IL: TFA) as the content of technology education. It is organized around communications, construction, manufacturing, and transportation as major technological systems. Within that conceptual framework, we also accept the organizing concept that there is a common process found in each system, broadly consisting of *input*, *process*, and *output*. From this, we derive specific courses.

At another level, instructional concepts also affect curriculum. These involve how the content is taught. These are district or individual concepts that affect organization and presentation of the technology education content. For example, conceptually, courses may be structured as lecture and memorization. They may rely heavily upon textbooks and rote response, or they may be structured so as to encourage experimentation and reward creativity. Identifying prevailing instructional concepts has a direct influence upon specific course development.

Determine Scope and Sequence

A sequence provides a learner with opportunities and experiences that build on previous knowledge and skills. Early in the process of curriculum development, a natural sequence from simple to complex should be identified for the new curriculum, regarding content, learning, and activities. Scope, on the other hand, deals with the breadth of content, learning, and activities. The technology education content presented in this guide outlines the scope and sequence of technology education as a discipline. As learners encounter this new curriculum, developers need to take into account their level based on previous learning. The scope and sequence appropriate for that level then suggests itself by viewing the technology education content chart (Figure 3) both horizontally for systems content and vertically for learning-level content.

. . . sequence provides a learner with opportunities and experiences that build on previous knowledge and skills.

Regardless of school size, the technology education program should provide a variety of offerings in each system. Courses developed should be sequential, beginning with broad orientation and awareness of subject matter (the left side of the content chart in vertical slices), followed by more specialized experiences (the right side of the content chart in horizontal slices). This provides a smooth continuum that allows students to move from a beginning foundation phase, introducing basic concepts, knowledge, skills, and attitudes, to a series of developmental experiences that serve as the transition from basic learning to the pursuit of specialized content interests at a higher level.

Provide Upper-Level Flexibility

Another consideration, alluded to earlier, is that instructional methods must change along with the change of content as the technology education curriculum is revised. This is particularly true in the delivery of upper-level student options.

Courses serve only as an organization for content. Students elect courses with a purpose or application in mind. The methodology brings the content and the student together through a meaningful set of learning experiences that help students attain their objectives. As a result, the methodology must be such that it will accommodate nearly every student that might elect an upper-level course.

. . . instructional methods must change along with the change of content . . .

Students are usually asked to select courses early in the second semester of a given school year. This might occur between January and March, so by spring, students are programmed for the next year. As a result, schools typically know which students will be in each class some five or six months before the class actually begins.

During this period, including the summer months, there is sufficient time for teachers, parents, and counselors to help each student clarify objectives, select appropriate content to be learned, and organize a set of learning experiences. These learning experiences might occur in the school laboratory, in business or industry, or at a postsecondary technical school or university. The teacher thus would function as a facilitator in this learning process. Several examples illustrate how this organization can work.

. . . help each student clarify objectives, select appropriate content to be learned, and organize a set of learning experiences.

If a student is interested in building maintenance, a construction course might be selected in the spring as the most appropriate course. Within that course, however, the student might be taught custodial work or maintenance, depending upon the student's interests and abilities. If the student shows an interest in operating a cleaning service or a business such as painting, plumbing, or landscaping, then concepts of enterprise or small business management could also be appropriately emphasized for this student.

In another instance, a student might want to be an architect. This requires university preparation. In this case, instruction would focus on preparation for continued postsecondary education. Along with a good background in mathematics and physics, the student might again elect the construction course to learn concepts of building and construction planning. Instruction might take place in the school laboratory, on a school-related building project, as a part of a co-op experience at a local architectural firm, or in the city planner's office.

Another student might be interested in inventing, research, design, and just making things work more efficiently. This student might elect the manufacturing option. Tailoring this course, the student could be challenged to design an automated system to produce a given part or product. This experience could include not only the technical aspects of problem solving and inventing, but also the process of obtaining a patent for a product or process.

. . . students with a wide range of interests and abilities can be served . . .

One final example might help to illustrate how upper-level courses might be delivered. Suppose a student is interested in teaching technology. In this case, the student could select the technology course that best represents an area of interest. As a part of the course, the student could co-op with the teacher. An appropriate, specific assignment might be to assist with instruction in a Level I, II, III, or IV technology course.

The list of options is endless. The point is that with comprehensive curriculum design and flexible course construction, students with a wide range of interests and abilities can be served by technology education. Some specific programs, especially appropriate for upper-level application courses, are described in Section 6.

Course Framework (Goals, Objectives, and Competencies)

Objectives for content included in lessons, units, or courses are an outgrowth of the stated goals or purposes of technology education. Goals form the framework for objectives. If one of the goals for technology education is to provide students with an overall view of technology education, then, broadly, students will be exposed to the communications, construction, manufacturing, and transportation systems.

Goals form the framework for objectives.

An objective, however, is much narrower and should refer to an instructional outcome. Objectives are narrow in scope, describe precisely what the content will be and what responsibilities students and instructor have, and suggest the nature of evaluation. Objectives are written after goals have been stated and content has been selected. Objectives should consist of three parts: 1) the behavior students will exhibit; 2) the conditions under which students perform; and 3) the competencies the students should achieve.

If the goal is to teach students about communications, construction, manufacturing, and transportation, then a detailed course objective might be:

> **Objective**
>
> Students completing the Introduction to Technological Systems course will be able to identify inputs, processes, and outputs of the communications, construction, manufacturing, and transportation systems consistent with the handouts and discussions in class.

. . . competencies describe exactly what the students will be able to do upon completing the program.

At the next level of course development, competencies are based solely on specifically stated student outcomes that have been verified as being essential for successful learning in a particular area. These competencies describe exactly what the students will be able to do upon completing the program. Terminal performance objectives and performance tests are developed based on competencies established at the beginning of the course. They thus provide a detailed guide to student evaluation.

To continue the example, if the goal is to teach students about communications, construction, manufacturing, and transportation, and a course objective is that students will be able to identify inputs, processes, and outputs of these systems, then a reasonable competency would be:

Competency

Students will be able to identify characteristics of technology.

This is reasonable based on the goal and objective. Students will not have done well in the course if they cannot demonstrate that they have attained this competency.

Course Components

Course Description

A course description explains what the course is about and lists goals and objectives of the course. It is written by the instructor to clarify the course, place the course in the sequence of the program, specify if any prerequisites are needed, and suggest the kinds of typical activities that students can expect. It should be short and concise. A typical course title and description of an introductory technology education course might be:

Course Title

Introduction to Technological Systems

Course Description

This course is a beginning survey of the four systems of technology; their evolution, utilization, and significance; their common input, process, and output model; and their social, economic, and cultural impact upon society.

Content Outlines

The course outline is usually a beginning step in the development of a specific course.

The course outline is usually a beginning step in the development of a specific course. It is a skeleton framework of the course developed by the instructor. The instructor may use a variety of resources to develop the course, such as another outline as a base, a personal analysis, or existing materials or guides. The technology content chart in this guide (Figure 3 in Section 1) is suggested as a basis for technology education courses in Wisconsin. The chart can be followed vertically for broad, comprehensive courses, or any of the four systems can be developed in detail by following it horizontally.

Appropriate Activities

Once the course outline has been developed, the next step is to develop appropriate specific activities to reinforce course objectives. Activities such as reading guides, group work, home assignments, films, slides, and tapes,

information and instruction sheets, and other kinds of manipulative assignments should be carefully planned to meet the objectives and provide the competencies associated with the course. To a certain extent, activities will have to be based on the equipment available in the school or district, but this should not limit creativity in devising activities. There are various and unusual opportunities one can provide with the cooperation of other teachers, business and industry representatives, community people, and parents to help meet course goals and objectives.

Student Evaluation

Curriculums include objectives which specify the behavior of the student, the conditions the student performs under, and the competencies desired from the student. An instrument to assess student progress to determine if students learned the content can then be based on the course objectives. Did the student learn the content stated in the objectives? Were the activities appropriately completed? Can the student demonstrate the desired competencies? If the objectives were written and developed with care, student assessment follows naturally from them.

If the objectives were written and developed with care, student assessment follows naturally from them.

Sample Format

The following formats are ways to pull these course development ideas together. They list the variables discussed above that should be considered by the instructor developing a new course of instruction. They are not the only ways of organizing this material, however. Others ways may be more useful in particular situations.

Course	**Activity**
Title	Title
Description	Level
Objectives	Objective(s)/Competency
Content Outline	Equipment/Material(s)
	Methodology
	Teacher Guide
	Student Worksheet
	Evaluation

5

Introduction

Using the content chart (Figure 3) given in Section 1, it is possible for local school districts to identify a specific scope and sequence of a technology education program for grades K-12. As each school district develops its technology education program, consideration must be given to both students and local community needs. Districts must make a concerted effort to provide a comprehensive, action-based program. Actual program development, however, should take place only after the overall program goals have been set through a process such as that outlined in Section 4.

Program goals may include, but not be limited to, providing students with:

- knowledge of and an appreciation for the importance of technology;
- the ability to apply technical concepts safely and efficiently when working with tools, materials, and processes;
- opportunities to develop individual talents to the fullest extent possible;
- opportunities to apply problem-solving techniques;
- opportunities to apply other school subjects in a technical setting;
- opportunities to strengthen their personal creativity and individual abilities;
- an understanding of how technology has changed and how it continues to change;
- knowledge and skills necessary for entry-level employment;
- knowledge and skills so they may become wise consumers of goods and services; and
- knowledge and skills so they have the ability to make more informed course and career choices.

. . . districts can begin the task of developing their own, customized, K-12 program model, consistent with established district and program goals.

With the goal-setting task completed, districts can begin the task of developing their own, customized, K-12 program model, consistent with established district and program goals. From the program model, districts will create or adopt courses that will help implement the district's program goals. Samples of both a large and a small model were given for general reference in Section 1 and, in a simplified form, appear here in Figure 9.

Program Model

The core part of the program model consists of four levels, which should be presented by all districts. As noted in Section 1, Levels I (awareness), II (introduction), III (exploration), and V (applications) remain the same for all programs. Small programs, however, may not have the staff or facilities to provide the detailed content about each technological system

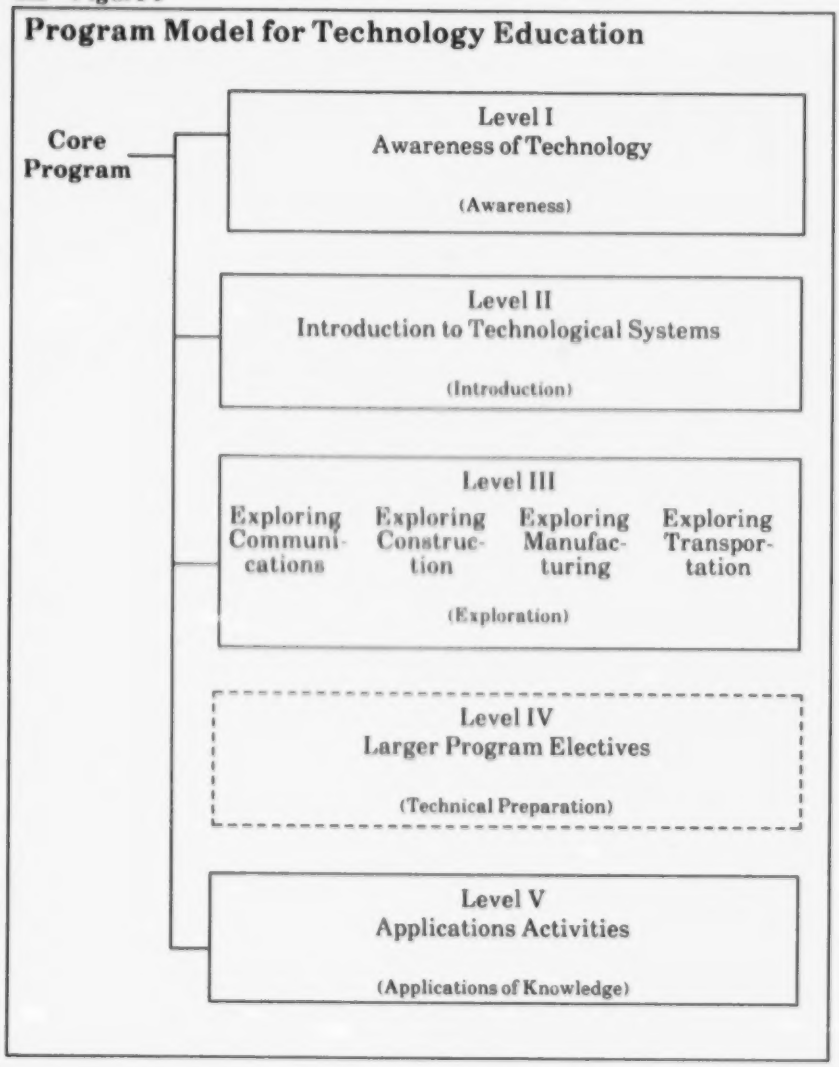
that is given in courses at Level IV (electives). Even small programs, however, will be able to provide some of the application experiences of Level V. These can even be worked into the curriculum at any of the previous levels, in some form.

As a rough guide, technology awareness (Level I) would be implemented in the elementary grades, and the introductory (Level II) and exploratory (Level III) courses would be implemented in the middle and early high school grades. Application experiences would also usually begin in the middle and high school grades. Actual grade placement and implementation of these levels might vary between districts.

It is . . . the sequence of the core program that is critical, not the grade level at which it begins.

It is rather the sequence of the core program that is critical, not the grade level at which it begins. Students should not be exploring one of the systems of technology (Level III) until they have taken an introductory program that introduces them to all four systems of technology (Level II).

Figure 9



Level I: Awareness of Technology

The first level of the program is designed to be an integral part of the elementary curriculum and could be presented by staff members other than technology education teachers as they teach mathematics, science, language arts skills, and other subjects. Technical concepts can be introduced and integrated into the existing curriculum at this level, supported by providing teachers with individual activity packets.

Level II: Introduction to Technological Systems

Level II introduces students to all four systems of technology. Specifically, students in the middle school grades have an opportunity to explore communications, construction, manufacturing, and transportation systems as part of a single course offering.

Level III: Exploring Technology Systems

Middle school students and students in their early years of high school should have access to Level III programs and courses. The program is designed to allow students to explore, in more depth, one or more of the four systems of technology, each as a single course offering. An example would be an "Exploring Communications" course.

Level IV: Electives

An important consideration is that each *of the four systems should be taught.*

Level IV of the program model may be different for each school district or may not be possible at all in smaller school districts. Local differences that occur may be the result of student and community needs, funding, facilities, staffing, or local, state, and national issues that impact on the school district. Course options should parallel but not be limited to the four systems of technology. Level IV in the program model could include such programs as graphic communications systems, planning processes for construction, manufacturing materials and processes, technical elements of transportation (all elective courses), as well as application activities such as occupational preparation, cooperative (on-the-job) education, research and development, entrepreneurship, and the like (from the application level). An important consideration is that *each* of the four systems should be taught. Overemphasizing courses in any one system should be avoided as much as possible.

Level V: Applications Activities

As noted in Section 1, Level V is the applications level. Most programs will be explored at this point in a student's development, but some

of the experiences involved can be programmed into the other levels, as appropriate for each district.

Level V in the model is made up of experiences designed around the application of the technical knowledge received in the study of the four systems of technology. This may involve independent study, research and development exercises, community-based partnership programs, cooperative (on-the-job) opportunities, entrepreneurship programs, and the like. Some relevant experiences are described at greater length in Section 6, which explores delivery systems for technology education.

Content Model and Course Outlines

Once the program model is in place, school districts can begin identifying specific course content. Content is drawn from vertical divisions of the content chart through Level II. At Level III, horizontal slices begin to provide the detailed content needed for courses in any one of the four technological systems (see Figure 10). The actual content for these courses will depend on the length of time the course is offered. The content model is divided according to the four systems of technology. Content is organized from simple to complex, or left to right on the model. Following are general descriptions of courses that would be offered by all school districts. Specific content outlines for each course are also given, after this overview.

Once the program model is in place, school districts can begin indentifying specific course content.

Core Courses (All Districts)

Level I: Awareness of Technology

This content would consist of locally developed activities that integrate concepts of technology into existing school curriculums. Content is targeted at the elementary school, grades K-5.

Learner outcomes for this level could include but not be limited to

- providing students with opportunities to learn basic concepts of how society can create and control the environment;
- providing students with opportunities to apply science, mathematics, language arts, and other curricular skills;
- allowing students to work with tools, materials, and processes; and
- developing student awareness of technology and its impact on our lives.

Level II: Introduction to Technological Systems

This would be the first formal course offering in the technology education program. The course would provide students with a comprehensive introduction to all four systems of technology—communications, construction, manufacturing, and transportation. It is recommended that all students take this course whether they have future plans to enter the

labor market or to pursue postsecondary educational opportunities upon graduation. Levels I and II activities and courses draw their content from all four technical systems. The more time districts devote to these two levels, the more content can be covered. Figure 10 illustrates how content can be identified for a single course having a specific time allocation by presenting content from all four systems (viewed vertically) on the chart. A sample course outline is provided for this course at the end of this section.

Learner outcomes for Level II could include but would not be limited to

- providing students with an understanding of the scope of technology;
- providing students with an understanding of the basic management and organizational structure found in business and industry;
- developing in students the ability to work safely with tools, materials, and processes;
- assuring that students can identify occupations as they relate to academic and technical systems; and
- fostering in students the ability to research, plan, design, construct, and evaluate products and services of technology.

"Technology Education: 'The study of technology and its history, growth, and future development as they relate to industrial organization, materials, tools, processes, occupations, product, and problems.'"
–Symposium III Proceedings, John R. Wright, 1981

Level III: Exploring Technology Systems

This series of courses will provide a basic exploration of the various aspects of any one of the four systems of technology. Content for courses in Level III is taken horizontally, within one system, from the content chart (see Figure 10). As before, the amount of content included in each course depends on the time allocation, a decision that can be made locally.

Learner outcomes for the exploratory courses may vary slightly between the systems of technology, but overall learner outcomes are the same as those in Level II. Sample course outlines of each of the four exploratory programs are provided at the end of this section.

- Exploring Communications
- Exploring Construction
- Exploring Manufacturing
- Exploring Transportation

. . . the amount of content included in each course depends on the time allocation, a decision that can be made locally.

Students should be encouraged to complete exploration courses in all four systems of technology before they enroll in the course electives.

Electives

It is at the elective level (IV) that local school districts can begin to tailor technical programs to meet specific student and community needs. Course content should have as a basis the systems of technology, but courses may be developed that overlap one or more of the systems.

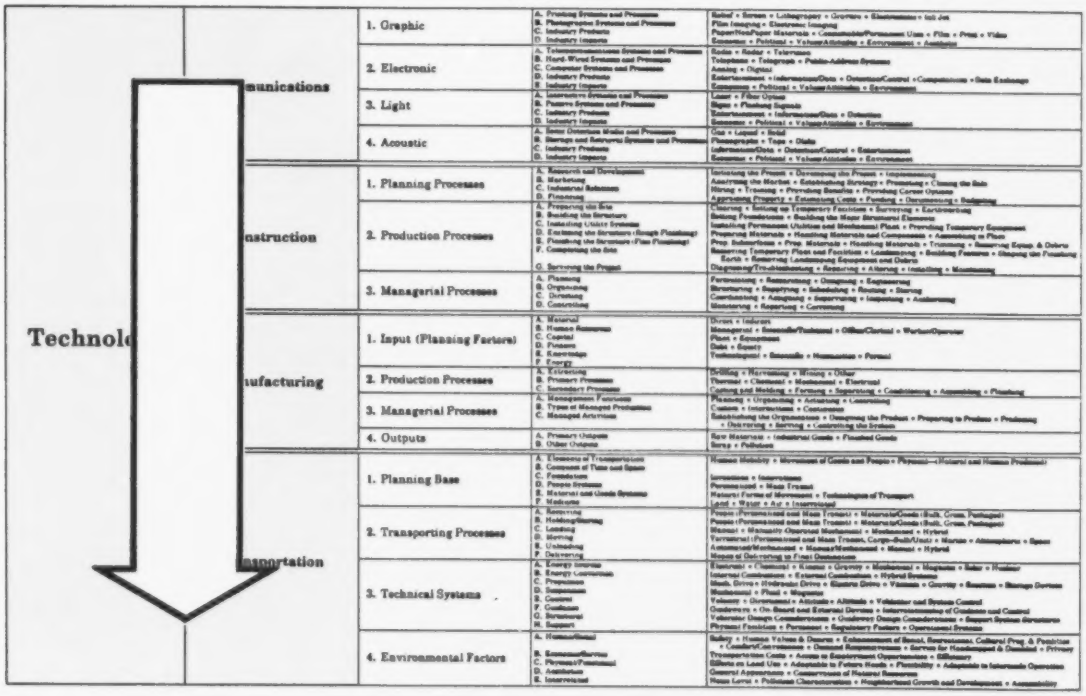
Level IV: Electives

Level IV course options provide opportunities for individualizing the technical program to meet the needs of local school districts. Specific

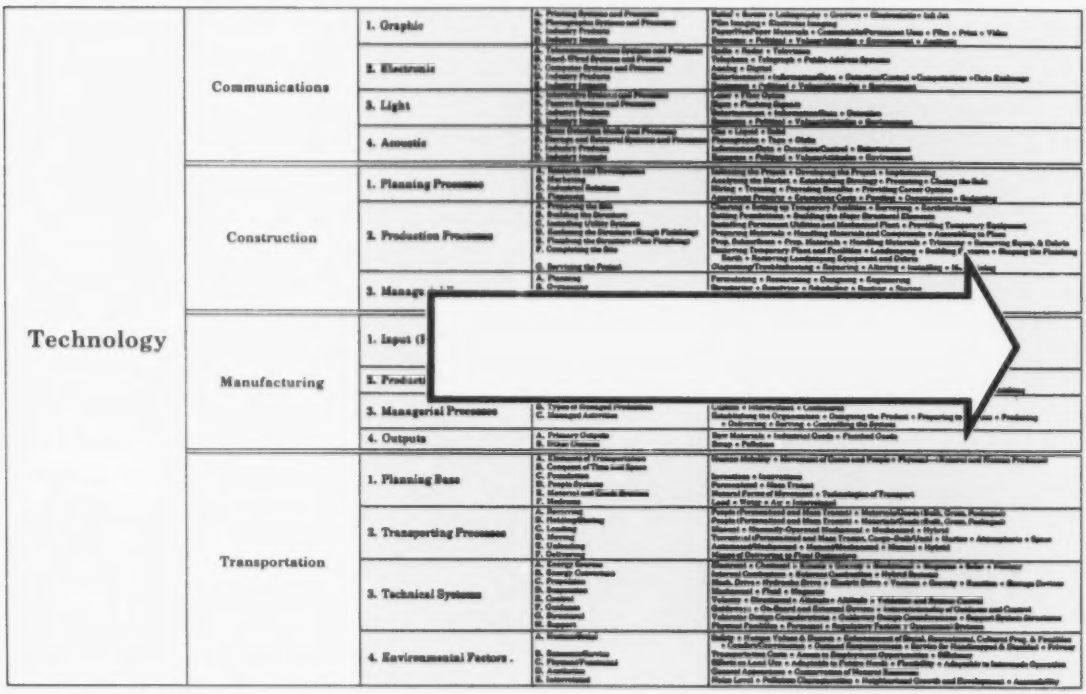
Figure 10

Content Model

Levels I and II (Content from all four systems)



Levels III and IV (Content from one of the systems)



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. . . local interests and resources will determine what courses can be developed . . .

learner outcomes will vary as courses are developed. Although local interests and resources will determine what courses can be developed in any given district, an effort should be made to offer courses in all four systems. Following is a sample list of possible course options in each of the four systems of technology.

Communications
Graphic Communications Systems
Electronic Communications Systems
Light and Acoustic Communications

Construction
Planning Processes for Construction
Constructing and Servicing Structures
Managing Construction Processes

Manufacturing
Manufacturing Materials and Processes
Designing Products and Planning Manufacturing
Managing Production Systems

Transportation
Technical Elements of Transportation
Planning and Designing Transportation Systems
Human and Goods Transportation Processes

Course outlines for these courses also follow.

Level II–Introductory Course

Introduction to Technological Systems

Description

Not everyone in our technological society is a producer or servicer of technology, but we are all consumers and users of the products of technology. This is a foundation course, appropriate for all students in the middle school or junior high school as a part of their general education program. The purposes of the course are to introduce the content base to students, enrich their understanding of technology-related careers, and serve their most basic needs as consumers in a technological world.

The course contains key elements of each of the four systems of technology—communications, construction, manufacturing, and transportation. The course is a systematic explanation, followed by "hands-on" experience with the most important processes, materials, tools, machines, management ideas, and impacts of technology. The course is not a prerequisite to other courses of the technology education program but is an introduction to technology complete in itself, as well as an orientation to the other elements of a school's technology education program.

Objectives

At the completion of this course, students will be able to

- understand and use the systems of industry and technology as they apply to communications, construction, manufacturing, and transportation;
  - apply the universal inputs of systems (i.e., capital, personnel, energy, etc.);
  - apply the productive processes of the identified system;
  - use and consume products;
  - manage the systems;
- understand and apply the research and development process; and
- understand and appreciate the relationship of service between the productive systems and the customer.

Content Outline

Evolution of Technology
- Extension of the human potential
- Development of tools and machines
- History of the "basic systems"

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Career information
  - Education
  - On-the-job training

Contemporary Technology
- Knowledge of materials
- Planning and sketching

Future of Technology and Industry
- Communications systems
  - Design and prepare message
  - Transmission and storage
  - Storage and retrieval
- Construction systems
  - Construction and servicing
  - Construction planning
  - Electrical and mechanical systems
- Manufacturing systems
  - Materials and processes
  - Product design and planning
  - Production systems
- Transportation systems
  - Elements of transportation
  - Planning and designing transportation systems

- Systems for human transportation
- Systems for product transportation

- Servicing the systems
  - Specific servicing relating to each area
  - Relationship of human input to the technologies
- Consumer/user
  - Human element—consumer/user

Level III–Exploratory Courses

Exploring Communications

Description

Communications is a major industry in our world. More than half of the American population is involved with the generation, manipulation, storage, transmission, or marketing of information. The purposes of this course are to introduce students to classifications, terminology, technical systems, and processes used by the industry and to provide sample activities that support those understandings. The course explores four major technical areas—graphic, electronic, light, and acoustic communications. Within each area, emphasis is placed upon the domestic and global impact of how people live. This is seen through economic, political, values/attitudes, and environmental impacts.

Objectives

At the completion of this course, students will be able to

- understand the limitations of humans communicating with humans through the five senses;
- recognize that technology amplifies, expands, and creates new abilities to receive and send information;
- recall that communications systems are defined as graphic, electronic, light, and acoustic;
- complete activities that develop understandings of the communications systems; and
- recognize typical products produced by the communications industry to create, manipulate, store, send or receive, and market information.

Content Outline

Introduction
- What is communication?
- How do humans communicate?
- Human limitations

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Career information
  - Education
  - On-the-job training

Technical Extensions
- Amplify
- Expansion
- New abilities

Classification of Communications Systems
- Graphic communications
  - Printing methods
  - Printing processes
  - Photographic methods
  - Photographic processes
  - Graphic communications industry/products
  - Impact of graphic communications
- Electronic communications
  - Telecommunication systems processes
    - radio
    - radar
    - television
  - Hard-wired systems
    - one way (voice, data, facsimile, P.A.)
    - two way (voice, telephone)
  - Hard-wired systems processes
    - designing
    - encoding
    - transmitting
    - storing/retrieving
    - receiving
    - decoding
  - Computer systems
    - analog
    - digital
  - Computer processes
    - input
    - storage
    - process
    - output

- Computer interface
  - human
  - machine
- Electronic communications industry products
  - broadcasting
  - telephone
  - telegraph
  - data processes
  - information services
- Impact
  - economic
  - political
  - values/attitudes
  - environmental

- Light communications
  - Interactive systems
    - sources (coherent, noncoherent)
    - processes
      - design
      - encode
      - transmit
      - receive
      - decode
  - Passive systems
    - sources
    - processes
      - design
      - encode
      - transmit
      - receive
      - decode
  - Light communications industry products
    - telephone
    - broadcast
    - data processing
  - Impact
    - economic
    - political
    - values/attitudes
    - environmental
- Acoustic communications
  - Sonic detection systems
    - gas
    - liquid
    - solid
  - Sonic detection processes
    - modulation
    - transmission
    - receiving
    - decoding
  - Storage and retrieval systems
    - magnetic
    - mechanical
  - Storage and retrieval systems processes
    - encode
    - store
    - retrieve
    - decode
  - Acoustic communications industry products
    - health services
    - information services
    - recording
  - Impacts
    - economic
    - political
    - values/attitudes
    - environmental

Managing Communications Systems

- Establishing the organization
  - Generate capital
  - Employ management
- Design the campaign
  - Establish theme
  - Determine media
- Design the message
  - Assess the audience
  - Research means to impact on audience
  - Develop message
    - storyboards and scripts
    - sketches
- Prepare to transmit the message
  - Plan and schedule production
  - Employ and train personnel
  - Prepare images or stage production
  - Procure materials
  - Establish physical facilities
- Produce the message
  - Print
  - Record

- Deliver the message
  - Broadcast
  - Ship
- Maintain financial and personnel records
  - Budgets
  - General and cost accounts
  - Wage records
- Liquidate company

Exploring Construction

Description

The construction system course provides students with a working understanding of the key elements associated with designing, planning, and constructing a structure on-site. Students learn major concepts through hands-on activities, using contemporary construction tools and materials. Activities involve a variety of types of construction, such as commercial and industrial buildings, bridges, and pipelines. Emphasis is placed on student understanding of major concepts associated with each main content element as well as interrelationship of management and production elements. (Time restrictions will limit the selection and number of activities for each element. Consequently, it is important that the instructor not lose sight of the total input-process-output model of a complete construction system.)

Objectives

At the completion of this course, students will be able to

- relate construction technology to the broader context of industry and technology;
- perform selected management practices in planning, directing, and controlling as they relate to construction production systems;
- perform selected industrial relations practices as they relate to a managed production system in construction;
- appreciate, understand, and perform selected production and servicing practices as they apply to construction products;
- understand the interrelationships within and between construction, the environment, individuals, and society;
- appreciate and have some understanding of constructed projects and the tools and materials utilized in their construction;
- develop an awareness of careers in construction technology;
- develop an awareness of the significance of construction industry and technology in the past, present, and future; and
- develop responsible and safe work attitudes and the ability to function as a member of a group.

Content Outline

Introduction
- What is construction?
- Why do we have structures?
- Human impact

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Career information
  - Education needed
  - On-the-job training

Managed Construction Processes
- Research and development processes
- Marketing
- Industrial relations/labor
- Financing

Production Processes
- Preparing the site
  - Clearing the site
  - Surveying for construction
  - Earthworking
- Building the structure
  - Setting the foundation
  - Building the major structural elements
- Installing utility systems
  - Installing permanent utilities and mechanical plant
  - Providing temporary equipment

- Enclosing the structure
  - Preparing the materials
  - Handling materials and components
  - Assembling in place
- Finishing the structure
  - Preparing subsurfaces
  - Preparing materials
  - Handling materials
  - Trimming
  - Removing equipment and debris
- Completing the site
  - Landscaping
  - Building features
  - Shaping and finishing earth
- Servicing the project
  - Diagnosing/trouble-shooting
  - Repairing
  - Altering
  - Installing
  - Maintaining

Managerial Processes

- Planning
  - Formulating
  - Supplying
  - Scheduling
  - Routing
  - Sorting
- Organizing
  - Structuring
  - Supplying
  - Scheduling
  - Routing
  - Storing
- Directing
  - Coordinating
  - Assigning
  - Supervising
  - Inspecting
  - Authorizing
- Controlling
  - Monitoring
  - Reporting
  - Correcting

Exploring Manufacturing

Description

The manufacturing system course provides students with a general introduction to the material processing and management components of a manufacturing activity. Emphasis is placed on the development of a conceptual understanding of (1) the six families of secondary material processes and (2) the managed sequence of activities used to convert a designer's ideas into a product that is produced and converted into money in the marketplace.

Objectives

At the completion of this course, students will be able to

- understand the major processes used to change raw materials into industrial goods and industrial goods into products;
- complete some common secondary material processing activities;
- understand manufacturing as it is related to the larger context of technology, industry, and society; and
- understand the managed activities used to design, specify, manufacture, and market manufactured goods.

Content Outline

Introduction to Manufacturing

- Manufacturing and society
  - Societal institutions
  - Impacts
- Manufacturing enterprises
- Manufacturing systems
  - Inputs
  - Processes
    - material processing
    - management
  - Outputs

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Career information
  - Education required
  - On-the-job training

Manufacturing Input
- Materials
- Human resources
- Capital
- Financing
- Knowledge
- Energy

Manufacturing Processes
- Extracting
  - Drilling
  - Harvesting
  - Mining
- Primary manufacturing processes
  - Thermal
  - Chemical
  - Mechanical
  - Electrical
- Secondary processing
  - Casting and molding
  - Forming
  - Separating
  - Conditioning materials
  - Assembling
  - Finishing

Managerial Processes
- Functions of management
  - Planning
  - Organizing
  - Actuating
  - Controlling
- Types of managed systems
  - Custom
  - Intermittent
  - Continuous
- Managed activities
  - Establishing the organization
  - Designing the product
  - Preparing to produce the product
  - Producing the product
  - Marketing the product
  - Delivering
  - Servicing
  - Control systems

Output
- Primary output
  - Raw material
  - Goods/industrial
  - Finished goods
- Other outputs
  - Scrap
  - Pollution

Evolution of Manufacturing
- Historical milestones
- Present-day manufacturing
  - Practices
  - Societal impacts
  - Personal interaction
- Future trends
  - Employment/jobs
  - Resource utilization
  - Computerization

Exploring Transportation

Description

This course is a conceptualized study of transportation systems dealing generally with the methods by which we move people and goods through various environments. The environments studied will be terrestrial, marine, atmospheric, and spatial with selected content from each in a past, contemporary, and futuristic perspective.

Objectives

At the completion of this course, students will be able to
- be aware of the need and function of transportation in society;
- understand the technical, social, and environmental aspects of transportation systems;

- develop technical problem-solving abilities and creative talents using the transportation of goods, materials, and people as a central theme; and
- have an enjoyable experience in the study of technology using transportation systems as a content focus.

Content Outline

Introduction
- What is transportation?
- How are products and people moved?
- Human limitations

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Career information
  - Education needed
  - On-the-job training

Technological Base for Transportation
- Elements of transportation
- Time and space limitations
- Transportation in the past
- People systems
- Material and goods systems
- Methods of transporting

Components of Transporting Goods/ Materials/People
- Receiving
- Storage
- Loading
- Moving
- Unloading
- Delivering

Technical Aspects
- Energy sources
- Energy conversion
- Propulsion
- Suspension
- Control
- Guidance
- Structural
- Support services

Environmental Factors
- Human-social
- Economic
- Physical
- Aesthetics
- Interrelationship

Graphic Communications Systems

Description

The graphic communications course provides students with an introduction to the graphic communications field. Emphasis is placed on the development of a conceptual understanding of the technical processes and managerial activities related to two major areas—printing and photography.

Objectives

At the completion of this course, students will be able to

- identify major areas associated with the graphic communications field;
- identify and use the materials and equipment associated with photography;
- compose and develop a photograph for an assigned theme;
- identify and use the materials and equipment associated with the printing industry;
- produce a product using a common printing process;
- identify and discuss the purposes of the graphic communications industry; and
- react to the way graphic communications affects the community, state, and nation in terms of social, economic, and political impacts.

Content Outline

Introduction to Graphic Communications
- Definition of graphic communications
  - Photography
  - Printing
- Uses of graphic communications
  - Information dissemination
  - Advertising
  - Entertainment
  - Packaging

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Career information
  - Education needed
  - On-the-job training

Photography
- Photographic film imaging
  - Light sensitive materials
  - Exposure systems
  - Processing systems
- Photographic electronic imaging
  - Light monitoring
  - Light generation
  - Exposure techniques
  - Monitoring techniques
- Sequence of photographic production
  - Image design
  - Image assembly
  - Image exposure
  - Image finishing
  - Image reproduction

Printing
- Use of printed materials
  - Materials
  - Paper
  - Nonpaper
  - Application
  - Consumable
  - Permanent
- Printing fundamentals
  - Printing sequence
  - Image design
  - Image assembly
  - Image conversion
  - Image carriers
  - Image transfer

- Impact
  - relief
  - lithography
  - gravure
  - screen
- Nonimpact
  - electrostatic
  - ink jet
  - laser

Managing a Graphic Communications Business

- Identify the need
  - Mass media
  - Individuals
  - Product market research
- Establish a business
  - Structure
  - Personnel
  - Financial
- Product design
  - Research
  - Design
  - Testing
- Production
  - Material procurement
  - Fabrication
  - Finishing
  - Quality control
- Marketing
  - Advertising
  - Sales
  - Distribution
- Accounting
  - Profit
  - Losses

Graphic Communications Industry

- Publishing
- Films/video
- Art/advertising
- Packaging
- Commercial art
  - Printing
  - Photography

Graphic Communications System Support

- Economics
- Valves/attitudes
- Political
- Environmental

Trends in Graphic Communications

Electronic Communications Systems

Description

The electronic communications course provides students with a general introduction to contemporary communications technology including telecommunications, hard-wired, computer, light, and acoustic systems. An integral part of the course is an overview of the products and impacts of electronic communications systems and of the nature of the communications industry.

Objectives

At the completion of this course, students will be able to

- describe the major electronic communications systems;
- characterize the major components of electronic communications systems;
- determine the nature and composition of the electronic communications industry;
- conduct technical experiments in the area of electronic communications; and
- assess the social/cultural impact of communications products and technical systems.

Introduction to Electronic Communications

- Definition of electronic communications
- The nature of messages
- Types of electronic communications
  - Telecommunications
  - Hard-wire
  - Computer systems

Supportive Classroom Content

- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning

- Career information
  - Education needed
  - On-the-job training

Telecommunications Systems
- Fundamentals of electromagnetism
  - Magnetic fields
  - Electromagnetic radiation
  - Signal transmission
  - Application for system
    one-way signal generation
- Radio and television (microwave, satellite)
  - Design of message
  - Encoding the message
  - Transmitting the signal
  - Receiving the signal
  - Decoding the signal
  - Storage and retrieving

Hard-Wire Systems
- Fundamentals of electron action
  - Conductors
  - Insulators
  - Application for system
    one-way signal transmission
    two-way signal transmission
- Voice and data communications (telephone, telegraph, teletype)
  - Encode the message
  - Transmit the signal
  - Information processing
  - Information output
  - Computer interface

Radiowave
- Fundamentals of signal generation
  - Application
    two-way communications
- Radar/altimeter
  - Signal generation
  - Signal transmission
  - Signal reception
  - Signal interpretation

Electronic Communications Products
- Publishing
- Entertainment
- Information/Data exchange
- Detection
- Computation
- Control

Electronic Communications System Impact
- Economics
- Values/attitudes
- Political
- Environment

Trends in Electronic Communications

Light and Acoustic Communications

Description

Light and acoustical communications are found throughout contemporary society in varied applications. This course is designed to introduce students to various applications of the two systems. Students will also work with a variety of products and learn how they affect everyday living.

Objectives

At the completion of this course, students will be able to
- describe light and acoustic communications;
- list various applications of the two forms of communications;
- work with various acoustic and light generation communications equipment;
- develop products through the use of light and acoustical equipment;
- describe the social and economic impacts that result from the use of these forms of communications; and
- identify current and future employment opportunities in the light and acoustic communications industries.

Course Outline

Introduction to Light and Acoustic Communications
- Definition of light and acoustic communications
  - Interactive light communications
  - Passive light communications
  - Sonic communications

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Careers
  - Education needed
  - On-the-job training

Interactive Light Systems
- Laser
  - Source generation
  - Application
    - printing
    - manufacturing
- Fiber optics
  - Signal generation
  - Application
    - telephone
    - control

Passive Light Systems
- Signs
  - Types of signs
    - electric
    - gas
  - Application
    - advertising
    - control
- Flashing signs
  - Types of signs
    - electric
    - gas
  - Application
    - advertising
    - information
    - control

Acoustic Communications (Sonic)
- Signal generation
- Signal transmission
  - Gas
  - Liquid
  - Solid
- Application
  - Detection (sonar, altimeter)
    - signal generation and modulation
    - signal transmission and reception
    - signal decoding
  - Control

Acoustic Storage and Retrieval Systems
- Phonographic
- Tape
- Disks
- Processes
  - Encode
  - Storage
  - Retrieval
  - Decode

Light and Acoustic Communications Products
- Entertainment
- Information/Data storage
- Information/Data retrieval
- Detection
- Control

Light and Acoustic Communications Impact
- Economics
- Political
- Values/attitudes
- Environmental
- Aesthetic

Planning Processes for Construction

Description

Construction planning develops students' understanding of the practices involved in initiating, designing, financing, and engineering constructed works. To capture student interest

and provide perspective for the remainder of the course, the student is first introduced to the future of construction. This is followed by an analysis of the impact construction has on our environment, and of how our artificial environment came to be.

Objectives

At the completion of this course, students will be able to

- appreciate, understand, and apply the construction design process;
- understand the interrelationships between construction technology and community development;
- develop an awareness of the significance of construction technology in the past, present, and future;
- appreciate and understand selected production and management practices as they apply to the construction system;
- appreciate and understand the interrelationships within and between management and production practices in the construction system; and
- explore career opportunities in the planning phase of construction technology.

Content Outline

Future of Construction
- Impacts of construction

Historical Perspective
- Basics of structural systems
  - Types
  - Characteristics
  - Materials of construction
- Mechanical systems of structures
  - Water supply
  - Drain, water, and vent
  - Storm-water disposal
  - Ventilating, heating, and cooling
  - Electrical systems
- Construction methods
  - Joining materials
  - Erection techniques
- Regulatory and economic considerations

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Careers
  - Education needed
  - On-the-job training

Research and Development
- Initiating the project
  - Determining objectives
    - stating goals
    - consulting
    - establishing project criteria
    - evaluation
    - describing objectives
  - Researching
    - locating data
    - retrieving data
    - describing data
    - evaluating data
    - forecasting
  - Administering the project
    - directing
    - evaluating
    - selecting
    - presenting
- Developing the Project
  - Designing
    - evaluating concepts
    - evaluating solutions
    - selecting solutions
  - Engineering
    - interpreting drawings and reports
    - establishing design standards
    - analyzing problems
    - estimating size
    - detail designing
- Implementing the project
  - Contracting
  - Construction scheduling
  - Materials procurement
  - Supervision of construction

Marketing
- Analyzing the market
  - Local market
  - Market trends

- Establishing market strategy
- Product promotion
  - Word-of-mouth
  - Advertising
- Closing the sale

Industrial Relations
- Hiring
  - Determine labor sources
  - Select labor to meet needs
- Training
  - On-the-job
  - Formal training
- Providing benefits
- Careers in construction

Financing
- Appraising property
- Cost estimation
- Funding sources
  - Public
  - Private
- Documentation
  - Deed
  - Title
  - Liens
- Budgeting

Constructing and Servicing Structures

Description

"Constructing and Servicing Structures" places emphasis on the practices used to construct and service commercial, residential, and institutional structures. Students learn how the site is cleared, the structure designed, and the excavation completed. Students will be divided into groups for the purpose of constructing modules or small structures representative of commercial and residential construction. Activities also include servicing experiences to alter, repair, and maintain a project. Students will learn to read drawings, "take-off" lists of materials required, schedule the construction sequence, and account for costs involved.

Objectives

At the completion of this course, students will be able to
- perform selected production practices in preparing the site, building the structure, and servicing it as they apply to building construction production systems;
- perform selected management practices, including planning, organizing, directing, and controlling, as they relate to building construction production systems; and
- understand the interrelationships within and between management and production practices as they relate to constructing and servicing structures.

Content Outline

Historical Perspective
- Residential
- Commercial
- Bridges
- Pipelines

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Careers
  - Education needed
  - On-the-job training

Preparing the Site
- Clearing the site
  - Temporary access and protection
  - Reducing obstacles
  - Handling materials
- Setting up temporary facilities
- Surveying
  - Referencing to existing features
- Earthworking
  - Mobilizing equipment
  - Earthmoving
  - Protection for existing features or structures
  - Shaping and stabilizing earthwork

Building the Structure

- Setting foundation
  - Making and placing forms
    - building forms
    - assembling forms
    - treating forms
  - Reinforcement
    - cleaning and shaping
    - transferring and placing
    - supporting
  - Preparing foundation materials
    - handling materials
    - bonding materials
    - curing materials
    - controlling materials
    - removing forms
    - finishing
- Building the major structural elements
  - Preparing materials
    - layout
    - cutting
  - Fabricating components and temporary forms
    - Setting reinforcement
    - Handling materials
      - transferring
      - positioning
      - assembling
- Procuring labor
  - Subcontracting
  - Employing
  - Purchasing
  - Leasing
- Industrial relations
  - Hiring
  - Training
  - Providing benefits
  - Career options

Installing Utility Systems

- Installing temporary utilities
  - Sewer
  - Heating and ventilation
  - Electrical
  - Water
- Installing permanent utilities
  - Sewer
  - Water
  - Heating and ventilation
  - Electrical
  - Communications
  - Security systems

Enclosing the Structure

- Preparing the materials
- Handling the materials
- Assembling in place

Finishing the Structure

- Preparing the surfaces
- Preparing the materials
- Handling the materials
- Trimming
- Removing equipment and debris

Completing the Site

- Removal of temporary plant, facilities, utilities
- Landscaping
- Building asthetic features
- Shaping and finishing the earth
- Removal of landscape equipment and debris

Servicing the Structure

- Diagnosing
- Troubleshooting
- Repairing
- Altering
- Installing
- Maintaining

Managing Construction Processes

Description

This course in construction management provides students with an understanding of the key elements associated with managing a construction project. Students learn construction

management through various laboratory activities that involve planning, organizing, directing, and controlling various processes. Simulated or actual construction projects will provide opportunities for students to experience the interrelationship of all the management and production elements.

Objectives

At the completion of this course, students will be able to

- identify the elements of construction that are the responsibility of a manager;
- perform planning, directing, organizing, and controlling functions of the construction processes;
- participate in industrial relation activities;
- understand and identify tools, materials, and equipment used in construction projects; and
- develop an awareness of the past and present impact of construction on society.

Content Outline

Historical Impact of Construction
- Societal impact
- Economic impact
- Types of construction
  - Residential
  - Commercial
  - Bridges
  - Highways
  - Pipelines

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Careers
  - Education needed
  - On-the-job training

Planning for Construction
- Designing
  - Landscape
  - Architectural drafting
  - Mechanical systems
- Engineering
- Formulating
- Researching
  - Identifying the project
  - Initiating the project
  - Initial design

Organizing
- Structuring
- Supplying
- Scheduling
  - Short term
  - Long term
- Routing
  - Materials
  - Tools
  - Equipment
- Storing
  - Temporary
  - Long term
  - Materials
  - Tools
  - Equipment
  - Securing

Directing
- Coordinating
  - Materials
  - Equipment
  - Personnel
- Assigning
  - Personnel
- Supervising
- Inspection
  - Destructive
  - Nondestructive
- Authorization
- Rework

Controlling
- Monitoring
- Reporting
- Correcting

Manufacturing Materials and Processes

Description

The "Manufacturing Materials and Processes" course provides students with an introduction to (1) the properties of industrial materials, (2) production of standard stock, and (3) the transformation of standard stock into finished products. The emphasis of the course is on introductory concepts common to all processes as they relate to polymeric, metallic, and ceramic materials. The content is presented through activity-based methodologies. The goal is to provide a broad picture of materials and processes rather than to develop specific manipulative skills. A balanced emphasis between primary and secondary processing and among the six families of secondary processes is provided.

Objectives

At the completion of this course, students will be able to

- relate material properties and processing activities to the larger context of industry and technology;
- differentiate between primary and secondary material processing activities;
- describe the six major types of secondary material processing activities;
- perform selected primary and secondary material processing activities;
- describe the major properties of materials;
- perform selected tests to determine materials properties;
- exhibit safe work habits and cooperative attitudes; and
- select alternate materials that will meet product and consumer requirements.

Content Outline

Historical Perspective
- Materials of production
- Processes of production
- Product

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Careers
  - Education needed
  - On-the-job training

Introduction to Production Systems
- System components
  - Input
  - Processes
    - materials
    - management
  - Output
  - Operational context
    - goals (company)
    - objectives (societal)
- System elements
  - Manufacturing engineering
  - Production planning and control
  - Plant engineering
  - Quality control
  - Production
- System types
  - Custom
  - Intermittent
  - Continuous

Extracting Materials for Processing
- Drilling
- Harvesting
- Mining

Primary Processing of Materials
- Thermal processes
  - Heating
  - Cooling
- Chemical
- Mechanical
- Electrical

Secondary Processing of Materials
- Casting
  - Material preparation
  - Mold preparation
  - Pouring
  - Extraction of castings

- Forming
  - Selecting of shaping devices
  - Determining appropriate material temperature
  - Pressure applications
- Separating
  - Selecting cutting devices
  - Selecting cutting and feed motions
  - Securing work for processing
- Conditioning materials
  - Chemical
  - Thermal
  - Mechanical
- Assembling
  - Bonding
    - adhesives
    - fusion
  - Fastening
    - mechanical fastening
    - mechanical force
- Finishing
  - Finish selection
  - Material preparation
  - Applying finish
  - Curing finishes

Additional Production Considerations
- Operations required
  - Product analysis
  - Operation need
  - Process flow coordination
- Required support activities
  - Inspection
  - Transportation
  - Delays
  - Storage
- Sequencing of operations
  - Process sequence for product parts
  - Process sequence for product
- Designing tooling
- Quality control
- Monitoring production activities
- Scheduling human resources
- Categorizing material properties

Analyzing Primary Manufacturing Output
- Determining types of output
  - Raw materials
  - Industrial goods
  - Finished goods
  - Ancillary output

Other Manufacturing Output Considerations
- Scrap
- Pollution

Designing Products and Planning Manufacturing

Description

This course provides students with an introduction to the processes and materials needed for production. Emphasis is placed on the sequence of activities and actions that go into the design and production of various products. Students will experience, through hands-on activities, the planning of a manufacturing system.

Objectives

At the completion of this course, students will be able to
- identify the key elements in a manufacturing system;
- describe the impacts of manufacturing on society;
- understand the impacts of changing technology on the manufacturing of today's products;
- select a sequence of operations required to manufacture a product; and
- select from a variety of materials those materials best suited for a given product.

Content Outline

Historical Perspective
- Factors affecting how products are manufactured
  - Social
  - Economic
  - Environmental
- Material in production
- Equipment in production

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Careers
  - Education needed
  - On-the-job training

Discovering Manufacturing
- Transformation processes
- Managing the system
- Resources procurement
- Systems model

Obtaining the Materials of Production
- Direct
- Indirect

Obtaining Human Resources
- Managerial
- Scientific/technical
- Office/clerical
- Worker/operator

Capital
- Plant
- Equipment
- Insurance
- Materials

Finance
- Debt
- Equity

Knowledge
- Technical
  - Skilled
  - Unskilled
- Scientific
  - Research and development
  - Design
- Humanities
- Formal
  - Education
  - Training

Energy

Transportation Access

Other Considerations
- Identifying production systems
  - Input
  - Process
  - Output
- Systems elements
  - Engineering
  - Production planning
  - Plant engineering
  - Production
  - Quality control
- Systems types
  - Custom
  - Intermittent
  - Continuous
- Production methods
  - Operations selection
  - Operations sequence
- Determine space needs
  - Production
  - Raw material storage
  - Finished product storage
  - Human space needs
- Material Handling
- Monitoring production

Managing Production Systems

Description

This course provides students with an introduction to management functions in a production system. Emphasis is placed on overall system efficiency, process selection and sequencing, materials handling, production planning, control activities, work measurement, and product manufacturing. Activities include setting up a production system and working with engineering functions, materials selection and flow, and quality assurance.

Objectives

At the completion of this course, students will be able to

- develop an understanding of and assume the role of a manager;
- describe the relationship between the four major functions of the management process;
- place in proper sequence the operations of an efficient manufacturing process;
- list and define the three main types of production management;
- develop a product manufacturing schedule; and
- identify various materials handling needs as they relate to a product.

Content Outline

Managing Production Processes
- Human resources
- Materials
- Equipment
- Facilities

Supportive Classroom Content
- Safety
- Classroom management
- Careers
  - Education needed
  - On-the-job training

Management Functions (Historical View)
- Past vs. present management
  - Practices
  - Social implications
  - Personal interaction
    - career roles
    - customer roles
    - citizen/voter roles
- Future trends
  - Employer
  - Employee
  - Resource utilization
  - Computerization

Management Functions
- Planning
- Organizing
- Actuating
- Controlling

Types of Managed Production
- Custom
- Intermittent
  - Job lot
  - Batch
- Continuous

Managed Processes
- Primary
  - Thermal
  - Chemical
  - Mechanical
  - Electrical
- Secondary
  - Casting
  - Forming
  - Separating
  - Conditioning
  - Assembling
  - Finishing

Managed Activities
- Organization set-up
- Designing the product
  - Research
  - Development
  - Product engineering
- Preparing for production
  - Manufacturing engineering
  - Production planning and control
  - Employing personnel
  - Training personnel
  - Material purchasing
  - Quality control
- Producing the product
  - Material processing
  - Controlling quality
  - Safety
    - equipment
    - facilities
    - personnel
  - Wage administration
- Marketing

- Delivering
  - Inplant
  - Out-of-plant
    - wholesale
    - distribution
    - retail
- Product servicing
- Total system control
  - Materials
  - Personnel
  - Capital
  - Finance
  - Knowledge
  - Energy
- Managing manufacturing output
  - Product
  - Waste

Technical Elements of Transportation

Description

This course is designed to give students an understanding of how goods and people are transported. Students will learn the major elements in a transportation system. Students will also explore various mediums for transporting goods and people. Historical changes in transportation will be studied through hands-on activities so students will understand the advantages and disadvantages of various methods of transportation.

Objectives

At the completition of this course, students will be able to

- identify the elements of a transportation system;
- describe the relationship between time and space;
- explain why and how people are transported as they are today;
- describe the best method of transporting a given product by listing that method's advantages and disadvantages; and
- list and describe four major methods of transportation.

Content Outline

Historical Changes in Transportation
- Methods
- Costs
- Time
- Spacial

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Careers
  - Education needed
  - On-the-job training

Elements of Transportation
- Human mobility
  - Past
  - Present
  - Future
- Movement of goods and people
- Physical aspects
  - Natural forms of transportation
  - Developed forms of transportation

Conquest of Time and Space
- Past
- Present
- Future

Foundation of Transportation Change
- Inventions
- Innovations

Transportation of People
- Personalized
- Mass Transportation

Transportation of Goods and Materials
- Natural forms
- Developed forms

Mediums of Transportation
- Land
- Water
- Atmospheric
- Space
- Interrelated

Planning and Designing Transportation Systems

Description

This course provides students an opportunity to work with various materials and processes used in transportation. Emphasis will be placed on hands-on activities related to the technical aspects of transporting material, goods, and people. Students will be familiarized with differing aspects of energy, energy conversion, propulsion, control, and suspension processes in transportation systems.

Objectives

At the completition of this course, students will be able to
- identify major technical elements of the transportation system;
- describe what energy is, its types, and how energy is converted;
- develop an understanding of energy control and guidance systems;
- identify various propulsion and suspension systems; and
- describe the economic and social factors influenced by various elements found in a transportation system.

Content Outline

Historical Changes in Transportation
- Technical elements
  - Energy
  - Energy conversion
  - Propulsion
  - Suspension
  - Control
  - Guidance
  - Structural
  - Support elements

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Career information
  - Education needed
  - On-the-job training

Energy Sources
- Electrical
  - Electricity
  - Electronics
- Chemical
- Kinetic
- Gravity
- Mechanical
- Magnetic
- Solar
- Nuclear

Energy Conversion
- Internal combustion
- External combustion
- Hybrid systems

Propulsion
- Mechanical drive
- Hydraulic drive
- Electric drive
- Vacuum
- Gravity
- Reaction
- Storage devices

Suspension
- Mechanical
- Fluid
- Magnetic

Control
- Velocity
- Direction
- Altitude
- Vehicular
- System

Guidance
- Guideways
- On-board/external
- Relationship to control

Structural
- Vehicular design
- Guideway design
- Support systems

Support Elements
- Physical
- Personnel
- Regulation
- Operational systems

Human and Goods Transportation Processes

Description

This course gives students an understanding of the various processes which make up a transportation system. Students evaluate various types of vehicles used in transporting materials, goods, and people. Students also explore and work with the various steps used in material, goods, and human transport. This includes an investigation into environmental and economic factors which impact on transportation from start to finish.

Objectives

At the completion of this course, students will be able to
- describe various methods of receiving materials, goods, and people;
- list how goods, materials, and people can be held in a transportation system;
- describe how materials, goods, and people can be moved;
- describe how the total transportation system works by describing each of the key elements in the sysem; and
- develop an understanding of the various economic and environmental issues involved in the transportation of goods, materials, and people.

Content Outline

Historical Changes in Transportation Processes
- Receiving
- Holding/storing
- Loading
- Moving
- Unloading
- Delivering

Supportive Classroom Content
- Safety in the laboratory
- Classroom management
  - Cooperative learning
  - Student-managed learning
- Career information
  - Education needed
  - On-the-job training

Receiving
- People
  - Personalized
  - Mass transit
- Materials
  - Bulk
  - Gross
  - Packaged
- Goods
  - Bulk
  - Gross
  - Packaged

Holding and Storing
- People
  - Personalized
  - Mass transit
- Materials
  - Bulk
  - Gross
  - Packaged

- Goods
  - Bulk
  - Gross
  - Packaged

Loading
- Manual
- Manually operated mechanical
- Mechanized
- Hybrid
- Automated

Moving
- Terrestrial
  - Personalized
  - Mass transit
- Marine
  - Personalized
  - Mass transit
- Atmospheric
  - Personalized
  - Mass transit
- Space
  - Personalized
  - Mass transit

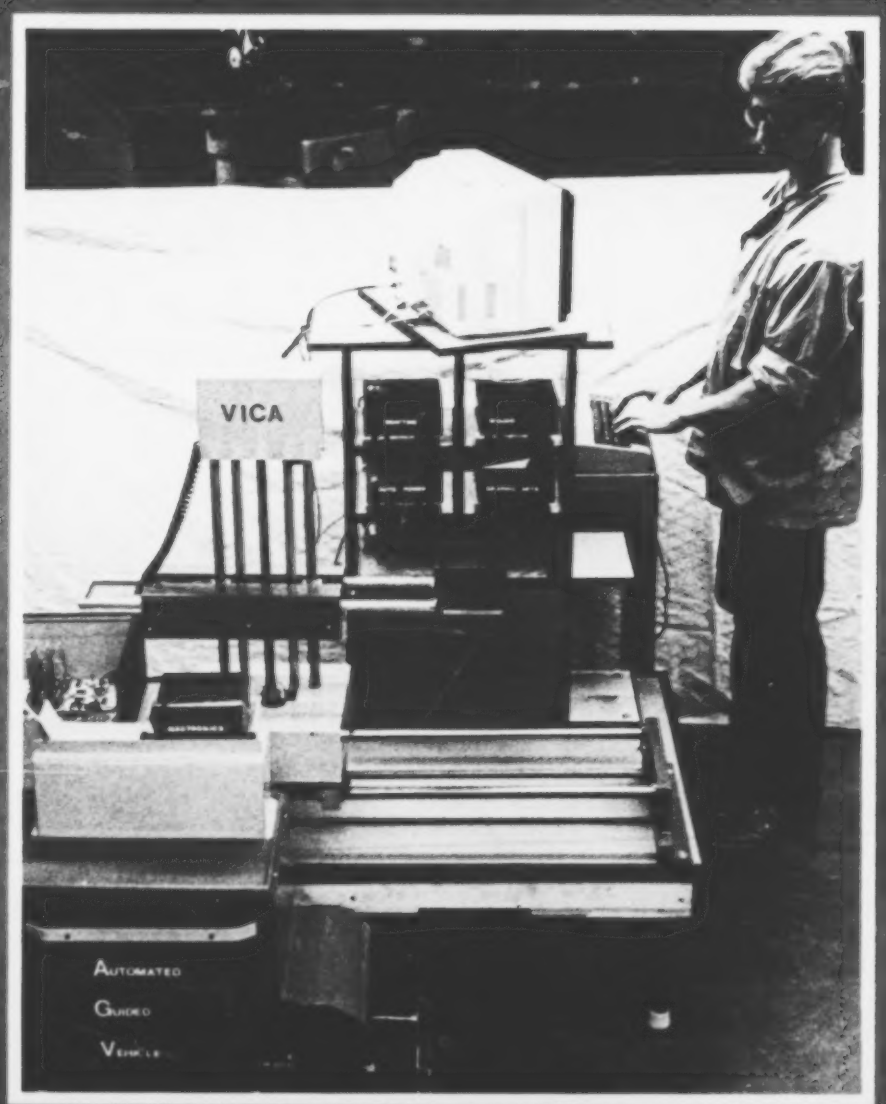
Unloading
- Automated
- Manual
- Manually operated mechanical
- Mechanized
- Hybrid

Delivering
- Wholesale
- Retail

Environmental Factors
- Human/social
  - Safety
  - Values/desires
  - Enhancement
    - social
    - recreational
    - cultural
    - facilities
  - Comfort
  - Demand/response
  - Handicapped services
  - Privacy
- Economic Factors
  - Cost
  - Access to employment opportunities
  - Efficiency
- Physical factors
  - Land use
  - Adaptability
  - Flexibility
- Aesthetics
  - Appearance
  - Conservation of natural resources
- Interrelationship
  - Noise
  - Pollution
  - Growth and economic development
  - Accessibility

Delivery Systems 6

Introduction
Strategy Options
Sample Programs
Secondary-Postsecondary Articulation



Introduction

A contemporary delivery system for technology education should include the integration of appropriate technical content, student organization activities, and community-based programs. The integration of these components into a sequential and comprehensive delivery system is the hallmark of a quality technology education program.

With any redefinition of the technology education curriculum, there is also a need for change in laboratory and classroom activities. This redirection of curriculum does not mean the end of this program as an activity-oriented program. What a new curriculum does necessitate is changes in the type of activities presented for students, as well as a wider range of instructional, administrative, and program integration and delivery strategies.

Strategy Options

An instructional strategy for delivering technology education content is a broad plan or method used for student instruction. Strategies should be specifically identified and utilized in meeting program goals, course objectives, and individual student needs. Much of the proposed technology education curriculum involves student-centered instructional activities for both group and individual student learning. For these kinds of emphases, the "station approach" serves both teacher and student needs well. The station approach is a series of learning cells or areas, each of which is dedicated to the delivery of specific technical content.

An instructional strategy for delivering technology education content is a broad plan or method used for student instruction.

Beyond that, delivery strategies chosen should be directly related to the course objectives and should be designed to meet the unique needs of individual students regardless of ability, special needs, or career aspirations. Depending upon course content, instructional strategies might include

- open entry and open exit scheduling;
- self- instructional materials;
- learning station laboratory arrangements;
- independent study contracts;
- computer-assisted instruction;
- small and large group activities;
- audio-visual materials;
- teacher assistants;
- community instruction;
- simulations;
- Vocational Industrial Clubs of America (VICA) activities;
- field trips;
- team teaching;

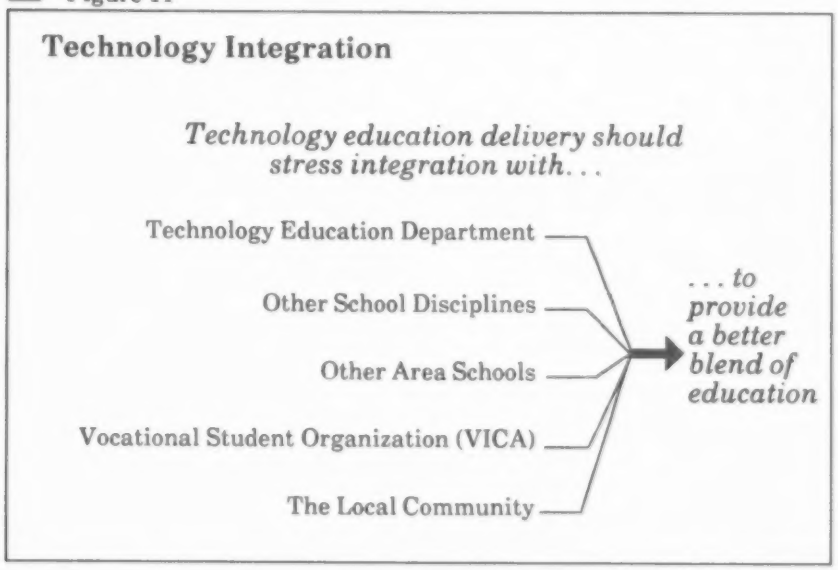
- interactive television network;
- interactive video; and
- cooperative (on-the-job) education programs.

There are also administrative strategies, usually the responsibility of district administrators or principals, that should be considered in devising appropriate technology education program delivery. These might include

- transporting students to other learning sites;
- sharing equipment;
- sharing instructors; and
- contracting with postsecondary education systems.

Regardless of which delivery strategies are selected, technology education programs should be a blend of programs within the technology education department, other school disciplines, other area schools, a vocational student organization (VICA), and the local community (Figure 11).

Figure 11


Technology Integration
Technology education delivery should stress integration with. . .
Technology Education Department
Other School Disciplines
Other Area Schools
Vocational Student Organization (VICA)
The Local Community
. . . to provide a better blend of education

Sample Programs

Various programs are already in use that foster this blending of interests and enhance the delivery of technology education for all students. Depending upon district goals and resources and upon program level, some of these will be more appropriate than others. Additional information on these programs can be obtained from the technology education consultants at the Wisconsin Department of Public Instruction.

Principles of Technology Course

Principles of technology is a course in applied science, usually for eleventh and twelfth graders. Its objectives are to increase the employability of vocational students, to emphasize principles rather than specifics of technology, and to generate interest in those vocations requiring a more rigorous study of science and mathematics. The course may be one or two years in length. It includes video presentations, demonstrations, workshops, and hands-on activities relating to the major systems of fluids, thermal energy, mechanics, and electronics. Specific topics studied include force, power, work, rate, energy, resistance, and radiation, among others.

Many schools will find it difficult or impossible to meet the needs of technology education students entirely through an in-school program.

Community-Based/Partnership Programs

Many schools will find it difficult or impossible to meet the needs of technology education students entirely through an in-school program. Several options exist to help schools meet the needs of students through partnerships and other community-based programs. The following list is representative. These programs also offer an excellent method for supporting the state's "Education for Employment" initiative.

Cooperative Work Experience. The school supervises an educational program conducted for the student jointly by the employer and the school. The school selects work sites in appropriate businesses, develops the objectives of the placement with the employer, assigns the students and monitors their progress, and provides related in-school instruction.

Field Study or Job Shadowing. The instructor can organize a series of sites for students. The sites would be selected to represent the content area of instruction. The student could observe and discuss worker traits and/or technology systems. The field study experience should be of short duration, consisting of only a few days. (Sample guidelines for a VICA-sponsored job shadowing program can be found in Appendix D.)

"A number of studies show that in-school employment is associated with greater employment and higher wage rates after the youth leaves high school."
–Meyer & Wise, 1982; Stephenson, 1981

Program Sharing. Program sharing can be done with another K-12 school. Sharing may be in the form of shared equipment, shared staff, moving students to a common site for instruction, or joint development of media, such as closed-circuit television. There may be other sharing possibilities, as well, depending upon particular situations.

Independent Study

Independent study is an arrangement whereby a specific educational plan is developed for an individual student. Most frequently it will be in a different area than those addressed in the specific course offerings or will be used for in-depth study in place of the regular courses. For example, an independent study course might be called, "Technical Problems in Manufacturing." The plan should include learning objectives, learning activi-

ties, calendar of events, and evaluation criteria. The plan should be developed jointly by the teacher and the student and will frequently result in a teacher-student contract. (Sample independent study forms can be found in Appendix D.)

Occupational Preparation Programs

"Each student should develop an awareness of his or her personal characteristics, an awareness of industrial and technology-related occupations, and a repertoire of basic occupational skills for an effective and satisfying career."
–The Technology Teacher, Perry R. Gemmill, 1984

On the basis of labor market data, student interest, and enrollment, larger districts may be able to support more specific occupational preparation programs. These programs should be designed to

- reflect stable and emerging occupations with ongoing employment opportunities;
- develop courses within the scope of the four organizers used throughout the technology education program (communications, construction, manufacturing, and transportation); and
- provide flexibility to allow students with differing, though related, job paths to benefit equally. For example, an occupational preparation program in communications should be flexible enough to benefit the student interested in telephone communications system design and servicing, as well as the student interested in satellite communications.

Teacher Assisting

Students considering a career in technology education, whether at the K-12 level, the vocational, technical, and adult education (VTAE) level, or industrial trainer or university level can be given the opportunity to develop teaching skills by enrolling as a teacher assistant. The student should carry out assignments significant to the teaching field, such as preparing class materials, presenting materials and/or demonstrations, keeping appropriate records, doing evaluations, and maintaining classroom equipment and the general environment.

Vocational Student Organization

The Vocational Industrial Clubs of America is the predominant student organization for technology education in the state of Wisconsin. The integration of VICA or VICA-like activities into a program provides a vehicle to enhance the delivery of content relative to entrepreneurship, leadership, and skill development.

The integration of VICA or VICA-like activities into a program provides a vehicle to enhance the delivery of content . . .

Recognition. VICA members are known in their schools and in their communities as leaders and as skilled professionals in training.

Personal Development and Leadership. VICA creates opportunities such as conferences, institutes, and seminars that enable students to exchange information with other students, teachers, and people from industry. Leadership is developed in chapter goals and in a program of work. Projects range from recreational, such as sponsoring a school dance, to

organizing community service programs. All activities provide an opportunity for personal growth and leadership development.

Skill Olympics. VICA can open doors to industry. VICA's annual U.S. Skill Olympics brings together industry and labor representatives, educators, and the public to watch more than 2,500 students compete in written and hands-on contests for a full day. Students have unparalleled opportunities to learn new techniques, meet industry representatives, travel, and gain peer recognition.

"The human side of enterprise is experienced as the students solve problems in organization, communications, authority, and decision making as they role play positions in a simulated manufacturing plant."
–The Technology Teacher, 1985

Entrepreneurship. VICA sections frequently have an organized business in operation. The enterprise demonstrates the leadership, start-up and risk, and dedication associated with running a business. An example at the senior high level of instruction might be a small engine repair service operated entirely by the students.

VICA is one of six vocational student organizations specifically endorsed by the United States Office of Education in the following policy statement.

> The United States Office of Education maintains a close relationship with the six vocational student organizations and welcomes their cooperation and support in strengthening our programs of vocational and technical education. Recognizing that the past performance and demonstrated potential of these six organizations are compatible with the overall purposes and objectives of education today, the United States Office of Education strongly endorses their objectives and seeks to involve their thinking in the development of our policies and plans.
>
> In view of this, our policy is as follows:
>
> 1. The United States Office of Education recognizes the concept of total student development as being necessary for all vocational-technical education students to enter the labor market and to assume successful roles in society.
>
> 2. The United States Office of Education recognizes the educational programs and philosophies embraced by the following vocational student organizations as being an integral part of our vocational education system of training.
>
> Distributive Education Clubs of America (DECA)
> Future Farmers of America (FFA)
> Future Homemakers of America (HERO)
> Future Business Leaders of America (Phi Beta Lambda)
> Office Education Association (OEA)
> Vocational Industrial Clubs of America (VICA)

The responsibility for instructional programs and related activities rests with the states and localities. It is our belief that increased efforts on the part of state education agencies to recognize and encourage the growth and development of these vocational student organizations are highly important and deserve the support of all leaders in American education.

The ideal delivery of technology education includes establishing a vocational student organization, if one does not already exist.

VICA was introduced in Wisconsin in 1973 when schools involved with the Wisconsin Industrial Education Student Association voted to affiliate with a strong national organization. Wisconsin VICA began its history during the fall of 1973 with 282 members in thirteen schools. Today Wisconsin VICA has chartered more than 140 school chapters and has a statewide membership of about 1,800.

As the curriculum has changed dramatically since 1973, expanding from industrial arts into technology education, so has VICA. New student competitive events have emerged, including inventions, CO_2 cars, energy, enterprise, and research and development. Wisconsin VICA has begun to enroll middle and junior high school members and is developing appropriate programs for this age group. The emphasis by business and industry on transferable "employability" skills in those they hire has caused chapters to increase their access to VICA's leadership conferences and contests. A "new VICA" consistent with the new curriculum is emerging.

Despite changes in emphasis and methodology, however, the principles and purposes of VICA remain.

- Encourage respect for the dignity of work.
- Teach how to live and work with others—to accept and be accepted.
- Involve young people with business, industry, and labor.
- Involve young people in community service and the democratic process.
- Stimulate interest in technology-related occupations and assist in career development.
- Offer activities that enhance the development of leadership and technical skills.

"Perhaps one of the most effective ways to impact youth, however, involving students in a student organization, has not received much emphasis in the literature. . . we must integrate student organization activities within the curriculum, for they help us to focus on the student, and assist us in educating the 'whole student.'"
–Symposium VI Proceedings, Roger Betts, 1984

The Local Chapter

The ideal delivery of technology education includes establishing a vocational student organization, if one does not already exist. In the local club individual members find new abilities, develop skills, travel, meet new friends, and serve their local community. Clearly quality programs attempt to provide these opportunities for their students. DPI technology education consultants can be contacted for further information on VICA's role in complementing the technology education curriculum.

VICA, like all organizations, requires a plan or program of work if it is to achieve its goals and purposes. A sample "Program of Work" form appears in Appendix D, as does a VICA "Field Study Program" form. The success of the program of work is dependent upon the involvement of every chapter member. For this, and other reasons, the VICA program should be intercurricular, not extracurricular, in nature. It is suggested

that no more than 20 percent of a club's activities should occur outside the school day.

The club advisor's role is that of facilitator. VICA promotes learning by doing, which explains why students should have primary leadership responsibility if they are to gain organizational, managerial, and leadership skills. It is the responsibility of the advisor to assure that the basic purposes of VICA are being met and that school policies and safety procedures are complied with; beyond that, club membership and activities are the responsibilities of the members.

. . . students should have primary leadership responsibility if they are to gain organizational, managerial, and leadership skills.

State Role

Wisconsin VICA state association officers (students) and staff have a number of resources available to assist local chapters and can be called upon to speak, provide audiovisual help, conduct workshops, and provide literature. State activities each year include leadership training conferences, skill olympics, professional development days, and coordination of two trips to national meetings.

National VICA

The national headquarters of VICA is located in Leesburg, Virginia. Each year national VICA provides local chapters and members with business and industry contacts, national skill and leadership event competition, state-level training, and a newsletter, which is published three times a year. National VICA stands ready to assist its 270,000 members and 13,000 chapters.

Secondary-Postsecondary Articulation

One of the goals of vocational education in a comprehensive program is to provide learning experiences that will give students the opportunity to develop the basis for advanced technical training. Such advanced training could be accomplished through university enrollment, apprenticeship programs, enrolling at one of Wisconsin's 16 campuses of the Vocational, Technical, and Adult Education (VTAE) System, or by enrolling at any of the various private vocational institutes or colleges in the state.

One of the goals of vocational education . . . is to provide learning experiences that will give students the opportunity to develop the basis for advanced technical training.

Due to local autonomy, which includes local responsibility for program and curriculum development, vocational programs in the K-12 districts and the postsecondary districts vary considerably in breadth and depth of content. However, an example of how a program might flow from K through 14 is given in the two pages that comprise Figure 12. Although the example illustrates a program with a technology education perspective, other areas or vocational disciplines could be structured in a similar

way. It should be noted that the articulation process will be more effective when competencies rather than courses are identified.

To facilitate student transition from the secondary to the postsecondary system, active linkages between the two educational levels are encouraged. Examples of shared activities might include

- participation on joint advisory committees;
- joint K-14 curriculum articulation by instructional staff;
- development and use of competency lists and advanced standing agreements and certificates; and
- contracting with a postsecondary system for instruction not available at a secondary school because of limited facilities, equipment, student interest, or staff expertise.

Figure 12

Sample Technology Education Program Flow (K-VTAE Levels)*

K-12 Levels

Level I	Level II	Level III	Level IV
Awareness of Technology	Introduction to Technological Systems • Communications • Construction • Manufacturing • Transportation	Communications Systems	Graphic Communications Systems Electronic Communications Systems Light and Acoustic Communications
		Construction Systems	Planning Processes for Construction Constructing and Servicing Structures Managing Construction Processes
		Manufacturing Systems	Manufacturing Materials and Processes Designing Products and Planning Manufacturing Managing Production Systems
		Transportation Systems	Technical Elements of Transportation Planning and Designing Transportation Systems Human and Goods Transportation Processes

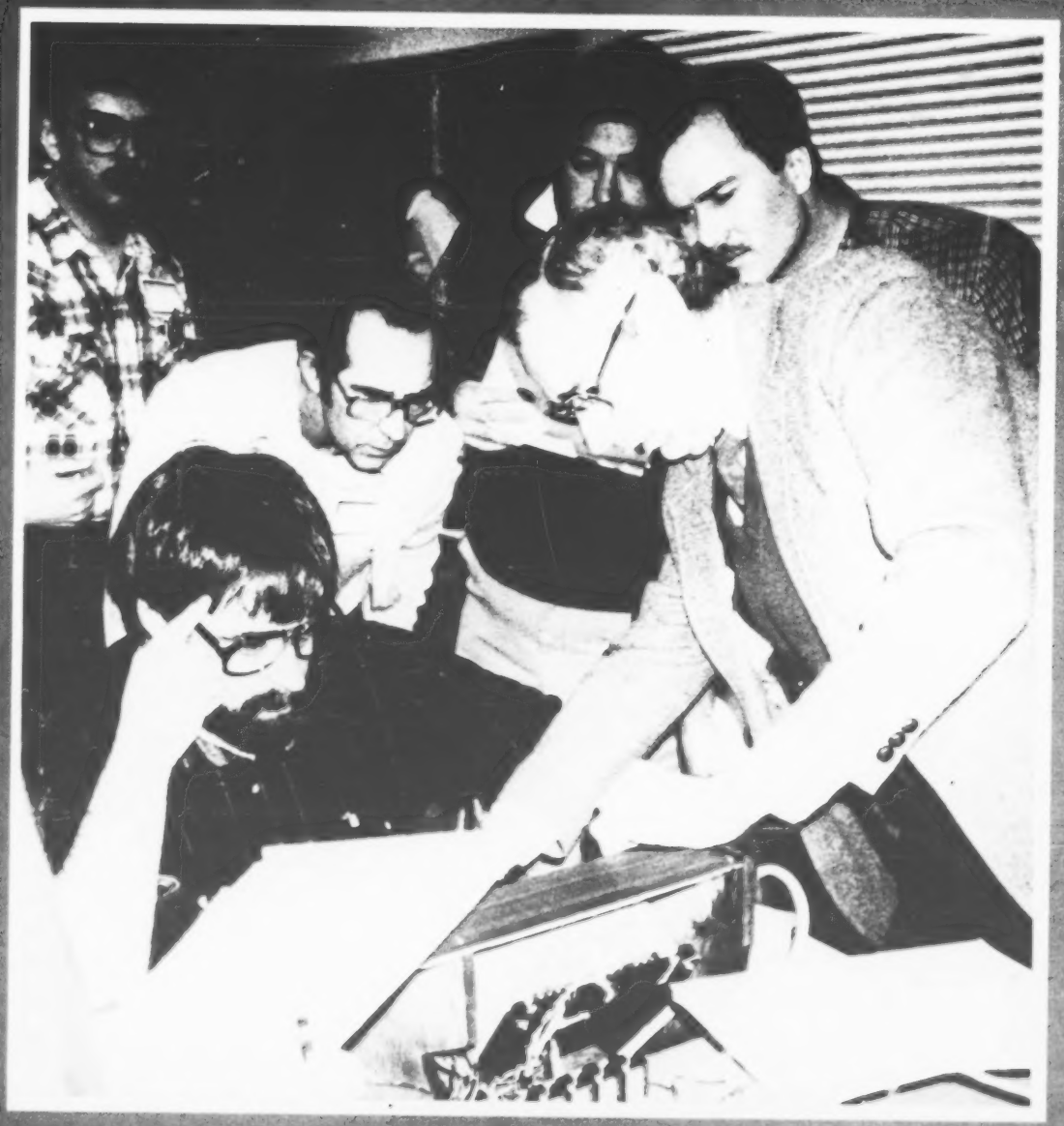
*Adapted from materials from Chippewa Valley Technical College, Trade and Industry Division, Eau Claire, Wisconsin

Postsecondary Levels

Short Term	One-Year Vocational	Two-Year Vocational	Two-Year Associate	Apprenticeship
		Electronic Servicing	Electronic Technology	Lineman
	Refrigeration Servicing Wood Technics		Air Conditioning Technology Structural Technology	Carpenter Bricklayer Sheet Metal Worker Plumber Steamfitter Electrician
	Mechanical-Computer Drafting Precision Inspection and Nondestructive Examination Welding Machine Tool	Machine Tool Fluid Power Maintenance	Electromechanical Technology Industrial Engineering Technology Mechanical Design Technology Fluid Power Technology	
Truck Driving	Auto Body Electrical Power Distribution Small Engine and Chassis Mechanics	Automotive Mechanics Diesel and Heavy Equipment Mechanics Agricultural Mechanics		

Resources and References 7

Introduction
Resources
References



Introduction

. . . the discipline continually must be prepared to absorb rapid and sometimes dramatic content change.

It may be that technology education by its nature is the most rapidly changing discipline in the schools. Encompassing, as it does, the fields of communications, construction, manufacturing, and transportation means that in addition to staying abreast of current educational thinking, the discipline continually must be prepared to absorb rapid and sometimes dramatic content change.

As true professionals, technology educators avail themselves of every opportunity to update and upgrade their knowledge and skills. A strong professional support system exists that makes this responsibility easier.

Resources

Professional Development

Being certified to conduct oneself in a profession does not alone make one a professional. Although a college degree in an appropriate field and a certificate to teach does provide entrance into the profession, the true professional accepts both accomplishments as only the first steps in a continuum of events, attitudes, and knowledge.

The professional technology educator

- believes education is a lifelong learning experience;
- has high standards personally and for students, the school system, the community, and the profession;
- is self-directed and a good self-critic;
- is secure enough to help colleagues look "good" in the eyes of others;
- treats each student as an individual and shows sincere concern about helping students become the best they can be;
- is dedicated to furthering the effectiveness of the teaching profession;
- is mature enough to accept criticism and offer constructive evaluation of others;
- is an active member of professional organizations at the local, state, and national levels;
- maintains confidentiality regarding professional and student matters;
- has a positive attitude toward colleagues, students, parents, and the community;
- is honest with himself/herself, students, parents, and the administration;
- does more than the minimum expected on the job;
- promotes technology education; and
- maintains a healthy sense of humor.

"Our goal is to give students the most up-to-date training possible. If that is to happen, not only must the equipment be state of the art, but so too must the instructors."
–Alfred W. Pelletier, 1984

Professional organizations, professional publications, conferences, continuing education, and work experience in business are available to help technology educators continue their professional development.

Professional Organizations

The technology educator can join a number of professional organizations—some open to all educators and some open only to technology educators. The benefits of a membership in an organization are wide and varied. Although some organizations foster research while others concern themselves with legislative issues, up-to-date information on the issues and activities of the profession is a direct outcome of membership in all professional organizations.

. . . up-to-date information on the issues and activities of the profession is a direct outcome of membership in all professional organizations.

In addition to belonging to general education associations, the professional technology educator should consider membership in special purpose organizations, as well.

American Vocational Association (AVA). An organization for educators teaching in any vocational area, the AVA effectively promotes vocational education, especially through legislative channels. An AVA convention is held annually, and the AVA publishes the *Vocational Education Journal*. The state chapter is the Wisconsin Vocational Association (WVA), and it can provide membership and additional organization and program information. The WVA address is 313 Price Place, Madison, WI 53705.

International Technology Education Association (ITEA). The ITEA, headquartered at 2000 Association Drive, Reston, VA 22091, is the largest association of technology educators. It provides its members with an active lobby in Washington, D.C., an annual international convention, ten issues of *Technology Teacher* magazine, professional research and leadership, and other services. Membership requires paying annual dues to the association.

Vocational Industrial Clubs of America (VICA). Professional membership is available to all technology instructors, whether or not they advise a local chapter. Contact Wisconsin VICA at the Department of Public Instruction for membership forms.

. . . the professional technology educator should consider membership in special purpose organizations, as well.

Wisconsin Technology Education Association (WTEA). The WTEA is the state affiliate of the International Technology Education Association. It provides members with news of the profession, sponsors the annual fall convention and other meetings, and is a good source of classroom ideas and materials. For more information contact WTEA Business Manager, Fryklund Hall, UW-Stout, Menomonie, WI 54751

In addition, technology educators should consider membership in trade and professional associations representing specialty areas such as the *Society of Manufacturing Engineers, National Home Builders, or Inter-*

national Graphic Arts Educator Association, to name a few. Some of the most current thinking in the discipline will first be explored in these associations.

Additional Resources

Publications. Professional journals and publications provide a wealth of information for the technology educator. Some are available through membership in a professional organization; others are available through subscriptions; still others are complimentary. Some journals will offer sample copies to prospective subscribers, which allows a preview of the publication's relevance.

Professional journals and publications provide a wealth of information . . .

Conferences. As noted earlier, throughout the school year, the technology educator can learn of the "latest" in education and business while meeting with colleagues at national, state, regional, district, and local conferences. The locations of these conferences change each year to encourage attendance. Conferences are regularly sponsored by business and industry, as well as the DPI, the professional associations, and universities. The technology education consultants at the DPI can provide current schedules.

Continuing Education Opportunities. Opportunities exist for the technology educator to progress beyond a four-year degree. Postgraduate study is available through the University of Wisconsin at both Platteville and Stout (Menomonie).

The Vocational, Technical, and Adult Education (VTAE) System, administered through 16 districts within the state, provides programs by field community services personnel employed by individual VTAE districts. More information can be obtained by contacting the director of instructional services or the student services department of the local VTAE district, the local cooperative educational service agency office, or the local high school.

Opportunities for the technology education instructor to secure hands-on experience should be investigated . . .

Continuing Business/Work Experience. While many experienced teachers without related work experience understand on-the-job conditions, actual employment can enhance all aspects of their instruction. The greatest benefit is to students as they learn from experienced teachers the "tricks of the trade," how to cope with job-related problems and frustrations, the importance of human relations and attitudes, and the importance of "added skills." Opportunities for the technology education instructor to secure hands-on experience should be investigated and pursued through community partnerships.

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In developing this curriculum guide, the authors relied upon many works by peers. Those involved in curriculum development in technology education will find the following materials especially instructive and innovative.

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Appendixes

A. Student Outreach

Reaching Special Needs Students
Sex Equity In Technology Education

B. Systems Taxonomies

Communications
Construction
Manufacturing
Transportation

C. Standards

Standards for Technology Education Programs
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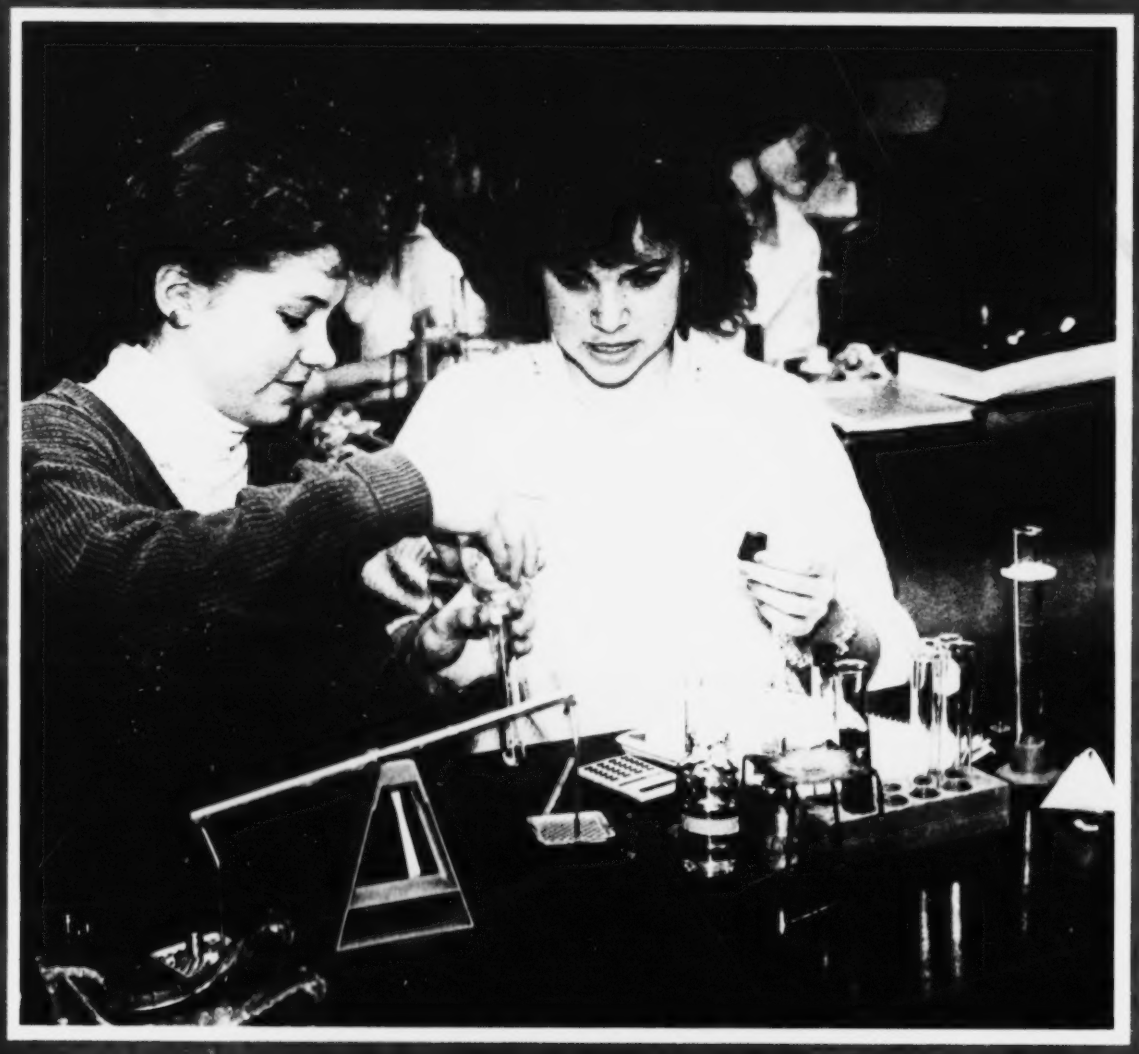
D. Sample Forms

Applications of Technology Program
Independent Study Program
VICA Forms

Student Outreach

Reaching Special Needs Students
Sex Equity in Technology Education



Reaching Special Needs Students

During the last two decades, there has been an increasing awareness of the need for disadvantaged and handicapped students, or special needs students, to participate in regular vocational education programs. These special needs students may have a great need for vocational education. Although opportunities are expanding, few students in this category continue their education beyond twelfth grade, and many who do not get the help they need drop out of school. These students need to master as many job competencies as possible, for the need to work is a universal human need. This section will help prepare both prospective and current technology educators to meet the individual needs of all students.

Special Needs Students Defined

Some students are classified as "handicapped" by Wisconsin's legally mandated multidisciplinary team processes and are labeled as mentally retarded, hard of hearing, deaf, speech impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, health impaired, or as having a specific learning disability. Because of their handicapping condition, these students find it difficult to succeed in regular technology education programs without special assistance.

"Disadvantaged" students have economic or academic disadvantages that may make them unable to succeed in technology education programs without special services and assistance. Students participating in free-lunch, reduced-lunch, or Aid to Families with Dependent Children programs are "economically disadvantaged." Students who score below the 25th percentile on a standardized achievement or aptitude test, whose secondary school grades are below 2.0 on a 4.0 scale, or who fail to attain minimal academic competencies may be considered "academically disadvantaged." Students who have limited English proficiency and those who are dropouts or potential dropouts from secondary school also fit into this category.

Impact of Current Legislation

Education for All Handicapped Children Act

The primary goal of Public Law 94-142, the Education for All Handicapped Children Act, is equal educational opportunity for all handicapped individuals who require special services. The legislation stresses that the handicapped are to be educated in the least-restrictive environment. Since the act's passage in 1975, the placement of handicapped students in regular classes has increased. This process, called "mainstreaming," has placed handicapped students in technology education classes.

Job Training Partnership Act

The Job Training Partnership Act, Public Law 97-300, establishes programs to prepare youth and unskilled adults to enter the labor force. It also affords job training to economically disadvantaged individuals and others who face serious barriers to employment and are in special need of such training to obtain productive employment.

Carl Perkins Vocational Education Act

The Carl Perkins Vocational Education Act of 1984, Public Law 98-524, requires that the full range of vocational education programs be accessible to all people, including the handicapped and disadvantaged. Currently in the reauthorization process, this act continues federal assistance for vocational education through the fiscal year 1989. Each state must set aside 10 percent of its federal allotment for handicapped people and 22 percent for disadvantaged individuals.

Under this act, handicapped or disadvantaged students and their parents must be informed of the opportunities available in vocational education at least one year before students may enter those programs, but no later than the beginning of ninth

grade. Each handicapped or disadvantaged student who enrolls in vocational education programs will receive an assessment of interests, abilities, and special needs; special services—including adaptation of the curriculum, instruction, and equipment and facilities—designed to meet specific student needs as determined by the assessment; guidance and career development activities conducted by professionally trained counselors; and transitional services from school to postschool employment and career opportunities. A sample of the kinds of questions asked in the secondary program evaluation is included at the end of this section.

Vocational Assessment

Vocational assessment, as an ongoing process, provides information about an individual's interests, abilities, and special needs. This usually begins before a student is placed in a specific program, and it should be updated annually. The vocational-assessment process should also provide useful information concerning student employability skills, such as work habits, socialization skills, work attitudes, and work tolerances. This information is used to develop a comprehensive profile that can serve as a basis for educational planning.

The following questions need to be answered for each special needs student enrolling in technology education classes:

- Has this student achieved vocational awareness, vocational exploration, or vocational preparation? How was this determined?
- Which occupational area(s) is this student most interested in? How was this determined?
- For which occupational area(s) does this student have aptitude and ability? How was this determined?
- What particular learning requirements (specific needs) will need to be met if this student is to succeed in a specific vocational education program? How was this determined?
- What job title, potential employment outcome, or postschool goal has been tentatively identified for this student?

Individualized Education for Employment Plan

Information obtained by answering these and other questions must lead to the development of an Individualized Education for Employment Plan (IEEP), which will be the basis for offering special services. For handicapped students, the IEEP could be an expanded part of the Individualized Education Program (IEP). A sample IEP form is included at the end of this section.

It is possible that students with handicapping conditions may not be considered handicapped for the purposes of a specific vocational education program. If these students are able to succeed in a technology education class without direct special education assistance, curriculum modification, or materials adaptation, a statement of the full extent of their participation in regular vocational education is all that must be included in the IEP. If a program modification in a vocational area is necessary, an IEP must be developed identifying the goals, objectives, and intervention strategies necessary to attain the goals.

Technology Educators' Role in the M-Team and IEP Preparation

The multidisciplinary team, or "M-team," is a group of individuals at the district level who determine a student's eligibility and need for special education services. Vocational educators are not generally viewed as regular members of the M-team, but they can be appointed as a full member or play a secondary or supplemental role at this level of the collaborative process. For example, they can provide M-team members with information about the purpose, nature, and extent of available technology education offerings so the group can make appropriate recommendations.

When a technology educator attends an M-team meeting, a large amount of data will already beavailable concerning the student for whom the IEP is written. Most of this data will focus on such items as IQ scores, standardized reading test scores, standardized mathematics test scores, physical characteristics, family situations, and social maturation. There may be questions about how this

information pertains to technology education programs—questions which IEP personnel cannot answer because they are not familiar enough with technology education programs. The vocational educator has to ask questions and become a participant in the IEP process by trying to determine information about the student that is work related.

- Is the student being placed in technology education for the purpose of further exploration, assessment, or preparation?
- What is the student's area of vocational interest? What does he or she want to do in relationship to work?
- Does the student have prior work experience? What is the student's physical and mental capacity for work?
- Has the student participated in any type of vocational exploration program?

These questions are designed to get the committee thinking about the vocational aspect of the student's development. Frequently, handicapped students are placed in vocational education programs simply because space is available. This practice does not meet the spirit of an *individualized* program and does not lend itself to the development of an effective vocation-related IEP. When the committee has vocation-related performance data, it can make more appropriate decisions about the student's vocational development and placement. (Georgia Department of Education, Division of Program Development, Office of Vocational Education. *Working with Special Needs Students: A Handbook for Vocational Education Teachers*. Atlanta: State of Georgia, 1982, pp. 11-12.)

The special educator determines the IEP's format, but federal and state laws require five main components.

- A statement of the student's current educational performance
- A statement of annual goals and short-term instructional objectives
- An outline of specific support services to be provided to the student and the extent to which he or she will be able to participate in regular education programs
- Specific evaluation criteria and schedules for determining whether the short-term objectives are being met
- Projections of when services will start and how long they will last.

Possible Support Services

Services are available that will enable special needs learners to participate in and benefit from regular technology education classes.

Adaptation of Curriculum. This means adaptation of *what* will be taught. Not all technology education content is of equal value to special needs students. Curriculum adaptation focuses instruction time on *essential* content, ensuring that valuable time is not devoted to less important content before the student has mastered the essentials. When adapting a curriculum, an educator should focus on a visible employment outcome to pinpoint the learning that needs to take place and eliminate unnecessary content. The educator should determine what a student *needs to know* to obtain entry-level employment and stress those concepts to the mastery level. This review may require eliminating the *nice-to-knows*.

Adaptation of Instruction. This means adaptation of *how* content will be taught. Teaching strategies that technology educators can use to better serve special needs students include

- developing instructional checkpoints to determine teaching effectiveness;
- starting instruction below the point where a student is functioning;
- providing students with choices;
- using direct teaching experiences (learning by doing) as often as possible;
- considering the time element of teaching (flexibility);
- encouraging students to "think through" situations;
- involving students in vocational student organization activities;
- using cooperative learning methods or small group activities;
- asking for feedback from students on teaching effectiveness; and
- varying the presentation of content.

Other modifications could include changes in

- grading procedures;
- test requirements;
- instructional sequence;
- classroom environment;
- project or report requirements;
- instructional pace;
- mathematics;
- listening demands;
- reading requirements; and
- writing requirements.

The student's ability to perform is more important than the time it takes to learn to perform. Once a special needs student has mastered a skill or task, actual performance time on the job will be comparable to that of a regular student. At that point, the time it took to learn will be of little significance.

Modified strategies and techniques work just as well for *non*handicapped students. This fact illustrates that students who have special needs are more like regular students than unlike them.

Adaptation of Equipment. Some technology education equipment can be used by special needs students without modification. When adaptations are necessary, it is usually possible to add hand controls to machines operated by foot controls or add foot controls to machines usually operated by hand controls. Lights can replace bells or alarms for hearing-impaired students, and Brailled tape can mark control dials for visually-impaired students.

Adaptation of Facilities. Facility adaptations generally concern administrators rather than teachers, but classroom teachers can remove unnecessary obstructions to allow ample space between aisles and around equipment. General accessibility standards should be reviewed to meet the needs of the student confined to a wheelchair.

Designated Vocational Instruction Concept. A working relationship between the special educator and the technology educator is essential to the successful mainstreaming of special needs students. Technology educators and other vocational educators can work cooperatively with special educators through the Designated Vocational Instruction (DVI) approach. The DVI concept is an interdisciplinary effort between special and vocational education to improve the scope, sequence, and quality of secondary-level vocational education for special needs students.

School districts participating in the DVI effort send a team of staff members (including vocational educators, guidance counselors, and at least one certified special educator) to a university training session. At the session, special education teachers serving as designated vocational instructors learn to provide instructional support to special needs students entering and participating in vocational education programs. As a result, special education's expertise in *how* to teach is blended with vocational education's expertise in *what* to teach. The DVI teacher works with other special education teachers, helping them understand the instructional support function of the DVI concept and facilitating communication among them.

Involvement in DVI need not bring additional costs to participating school districts. For more information or a copy of the DVI handbook, call or write: Vocational/Special Education Consultant, Department of Public Instruction, 125 South Webster Street, P.O. Box 7841, Madison, WI 53707-7841; (608) 267-9256.

Special Knowledge Required

To be eligible for a license to teach in Wisconsin's elementary and secondary schools, prospective teachers now must complete at least three semester credits, or the equivalent, in exceptional education. The equivalent might consist of study in existing required courses dealing with the exceptional child or other program requirements. These programs must provide certain basic information about

- the needs areas addressed by exceptional education as defined by state (Subchapter IV, Chapter 115) and federal (Public Law 94-142) laws;
- the major characteristics of various disabilities and how to recognize their presence in children and youth;
- various alternatives for providing the least-restrictive environment for children and youth with exceptional educational needs;
- effective classroom methods of teaching children and youth with exceptional educational needs; and

- referral systems, M-team responsibilities, and the IEP processes.

Any currently certified technology educator who does not possess this knowledge should obtain it.

Working with Special Needs Students

Many of the techniques known to be successful with special needs students are based on common sense and teacher creativity.

Academically and Economically Disadvantaged

- Use many visual teaching techniques.
- Use a hands-on approach whenever possible.
- Simplify vocabulary in written materials.
- Involve everyone in class discussions by walking around the room and calling on students at random.
- Praise students for portions of correct answers to questions.
- Use materials with high interest and low reading levels.
- Review frequently the material already learned.
- Encourage students to compete with themselves rather than with others in class.
- Relate subject matter to real-life occurrences as much as possible.
- Use a goal-setting format in class: adopt daily goals, weekly goals, semester goals, and so on.
- Accept the fact that the student may have a different value system than yours.
- Emphasize the employment opportunities available after completing the course.
- Be a consistent role model.

Mentally Retarded

- De-emphasize academic activities, and increase emphasis on actual performance.
- Build on what the student can do, not on what the student cannot do.
- Divide each task into smaller steps, and show the student how each step relates to the whole.
- Practice positive reinforcement.
- Emphasize continually the importance of good work habits in all tasks.
- Teach only those academic functions that are critical to actual performance.
- Do not assume what the student knows—find out.
- Do not "talk down" to the student.
- Use a hands-on approach whenever possible.

Learning Disabled

- Do not "talk down" to learning-disabled students; they possess average or above-average intelligence.
- Treat the student just as others are treated in all areas except those in which the student has specific problems.
- Use primarily an auditory approach to teaching if the student has a visual-perception-related learning disability, and talk the student through what is to be done.
- Use primarily a visual approach to teaching if the student has an auditory-perception-related learning disability, and actually show students what they should do.
- Use a hands-on approach whenever possible.

Emotionally Disturbed

- Have several variations of the same activity ready for use. Don't rely on a single approach to teaching because emotionally disturbed students may be easily frustrated.
- Use constructive criticism, always pointing out what was done right as well as what was done wrong.
- Correct students in a calm, matter-of-fact manner.
- Try to ignore inappropriate behavior as long as it is not dangerous to the students. Use positive reinforcement for appropriate behavior.
- Establish classroom rules initially, not as the class goes along.
- Do not threaten—respond.
- Be consistent with punishment and reward.
- Do not confront the student in front of the class—the attention this brings to the problem may reinforce the negative behavior.
- Use a hands-on approach whenever possible.

Physically/Other-Health Impaired

- Rearrange the classroom so the student can move about as freely as possible.
- Do not unnecessarily call attention to the student's disability.
- Be prepared to provide physical assistance if necessary.
- Do not be afraid of, or for, students. Treat them as normally as possible.

Visually Impaired

- Orient the student to the classroom, describing obstacles, traffic patterns, and so forth.
- Ask sighted students to be readers, and put lessons on tape.
- Do not seat the student where there is a glare on the chalkboard, desk, or work area.
- Use contrasting chalk or ink and large, clear lettering when writing on the chalkboard or assignment sheets.
- Present material using senses other than sight.
- Provide magnification devices.

Hearing Impaired

- Face the student when speaking, and speak slowly and clearly.
- Do not hesitate to repeat a word or sentence or rephrase a question.
- When a hearing-impaired student omits certain sounds from his or her speech, do not correct the student; instead, ask the student to repeat or rephrase and, if necessary, show what he or she means.
- Be sensitive to students who are hearing impaired in one ear only.

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Sample Form 1
Providing Adequate Preparation for Employment

The key questions asked in the Secondary Vocational Program Evaluation are summarized below. Read through the list, and determine how well your technology education program is preparing special needs students for employment.

Secondary Vocational Program Evaluation

1. Is information provided to special needs learners and their parents concerning the opportunities available in vocational education while they are in seventh or eighth grade?

2. Do all special needs learners enrolling in a vocational education program receive an assessment of her/his *interests*, *abilities*, and *special needs* designed to help them successfully complete the vocational education program?

3. Does the information gained in a vocational assessment result in a written plan for each special needs learner who enrolls in vocational education?

4. Does each special needs learner receive special services (adaptation of curriculum, instruction, equipment, facilities) designed to meet the *special needs* identified during a vocational assessment? Has curriculum been adapted to focus on mastering essential content first? To what extent do special education staff provide direct instructional support to special needs students enrolled in vocational classes?

5. Do vocational education staff effectively accommodate special needs learners? Are staff aware of differences and similarities between handicapped youth and disadvantaged youth? Have they been informed of the educational needs of each special needs learner?

6. Do special needs learners receive appropriate guidance counseling and career development activities?

7. Do special needs learners receive services to help them make the transition to postschool employment and career opportunities?

Sample Form 2
Individualized Education Program

Name of student (last, first, middle)	Date of birth (mo./day/yr.)	Chron. age	Telephone ( )	IEP beginning date
Parents or legal guardian	Address (street, city, state, zip)			District of residence
Area(s) of EEN	Support services provided	District of placement	Est. percentage of time Reg. ed. % Spec. ed. %	
Precautions (physical, medical, behavioral, etc.)		Person responsible for completing IEP		

1. Summary of present levels of functioning (including academic achievement, social adaptation, self-help skills, prevocational and vocational skills, psychomotor skills, and learning potential)

2. Specific educational services to meet exceptional educational need(s)

3. Supportive and related services to meet exceptional educational need(s)

	Regular	Specially designed (goals and objectives required)
4. Physical education	☐	☐
5. Vocational education	☐	☐

Name of student _____

Annual goal statement _____

Short-term objectives	Performance criteria and evaluation procedures	Anticipated timeline		To be completed within six weeks after placement	
		Beginning	Ending	Person(s) responsible	Interventions, methods, and materials

(Repeat this page for each goal)

*Sex Equity in Technology Education**

The term "sex equity" describes an environment in which individuals consider options and make choices based on their abilities and talents, not on the basis of stereotypes and biased expectations. It brings about freedom from favoritism based on sex. The achievement of sex equity enables both women and men of all races and ethnic backgrounds to develop skills needed in the home *and* in the paid work force, skills which are best suited to an individual's interests and abilities. It opens economic, social, and political opportunities for all people. It fosters mutual trust because people of both sexes are unrestricted in their roles.

Historical Background

During the last 20 years, efforts have been made to increase educational opportunity and eliminate discrimination. There is recognition of the deep-rooted and enduring social and economic changes that have occurred during this period. These changes require vocational educators to broaden their perception of the educational needs of male and female students of all races and various mental and physical abilities so that these students are better prepared to survive and thrive in a society characterized by changing conditions and expectations.

Educational equity as a specialized field of knowledge is in its infancy in terms of methodology and practice. Federal and state governments have seen the need for legislation to expand educational opportunities and to improve economic self-sufficiency for all people through changes in the educational system. The focus of early equity efforts centered on removing the overt barriers to equal access, treatment, and educational opportunity.

While compliance with nondiscrimination laws and removal of overt barriers to all courses of study and to all occupations are necessary, they are not sufficient to create an environment promoting educational equity and supporting expanded choices. Role stereotyping, bias, and lack of information about the impact of large social and economic trends perpetuate old patterns and old ways of thinking, feeling, behaving, and preparing for the future.

Traditionally, technology education has been linked to teaching the skills used in trade and industrial occupations. During the last few years, technology itself is becoming the foundation for technology education courses. Trade, industrial, and technology-related jobs currently and historically are dominated by males. As a result, technology education courses are perceived by females and males as predominantly a male domain.

Enrollment statistics reflect the following:

- Overall technology education Instructional Program Component (IPC) course enrollment is 94% male and 6% female.
- Overall technology education Occupational Preparation Component (OPC) course enrollment is 94% male and 6% female.
- Just a few more females elect technology education courses than are willing to declare an occupational goal and prepare for it. Therefore, the trend will remain for few young women to enroll at the IPC level.
- Of all the female students electing vocational education courses, 4.6% of IPC students and 8% of all OPC students are in technology education.
- Of all male students electing vocational education courses, 58% of all IPC students and 59% of all OPC students are in technology education.
- Disproportionate male enrollment appears in all technology education IPCs (see Chart 3).
- Disproportionate male enrollment appears in all technology education courses (see Chart 1).

These enrollment figures reflect, as well as perpetuate, gender stereotyping associated with technology, trade, and industrial occupations and segregation on the basis of sex in our current work force. Enrollment trends which indicate 80 percent or more enrollment by one sex are considered an indication of sex-role stereotyping, bias, or pos-

*Prepared by Barbara A. Bitters, Administrator, Vocational Equity and Single-Parent Programs, Wisconsin Department of Public Instruction, 1988.

sible discrimination. These statistics may indicate that females either see little value in learning skills taught in technology education, or they are not aware of what is being taught and how it might benefit them in the future. Reducing enrollment segregation and occupational stereotyping should be one of the goals of technology educators.

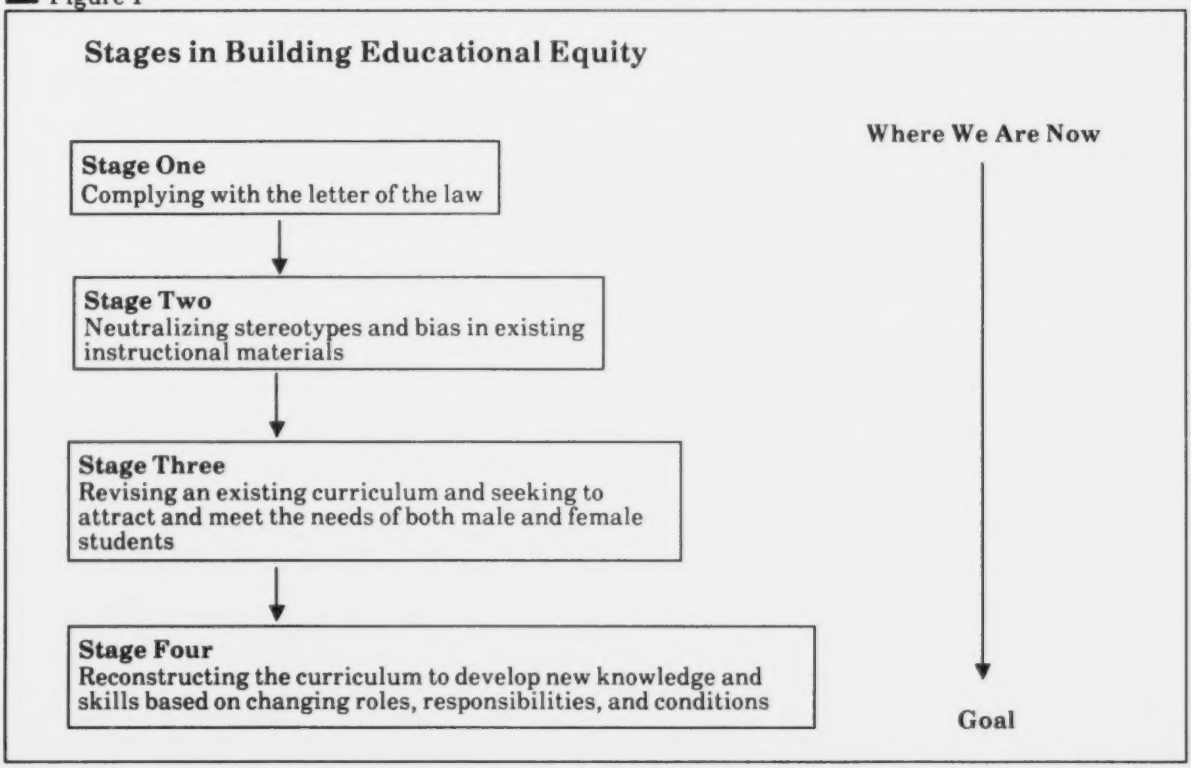
Achieving Equity through the Curriculum

In order for technology educators to develop a curriculum free of sex discrimination, they must be able to recognize sex bias and sex-role stereotyping in curriculum materials and in the classroom. Technology educators must devote consistent and informed attention to the goals of equity and how those goals can be achieved throughout the core of the teaching process: the learning environment, teacher-student interaction patterns, and the curriculum. The charts and checklists at the end of this section will provide technology educators with the basic resources to plan and develop an equitable curriculum.

Strategies for achieving equity through the curriculum have evolved over the last ten years. In the 1970s, the "checklist approach" was designed to address the goal of nondiscrimination. Currently, more sophisticated strategies are needed to weave equity into the fiber of each vocational course. The idea of student equity-related competencies as an integral part of curriculum objectives is new. Still, at the present time, all strategies are needed to achieve equity in technology education. All educators must take active steps to include equity-related concepts and skills in the curriculum at each stage of its development.

There are at least four stages that educators must consider when attempting to ensure that a particular curriculum supports the goals of educational equity, as illustrated in Figure 1.

Figure 1


Stages in Building Educational Equity
Where We Are Now
Stage One
Complying with the letter of the law
Stage Two
Neutralizing stereotypes and bias in existing instructional materials
Stage Three
Revising an existing curriculum and seeking to attract and meet the needs of both male and female students
Stage Four
Reconstructing the curriculum to develop new knowledge and skills based on changing roles, responsibilities, and conditions
Goal

Stage One: Complying with the Letter of the Law. At this stage, the policies and practices of the entire school district and each staff member must be reviewed. Federal and state laws prohibit discrimination in admission to any course or activity and prohibit separate courses for students on the basis of sex, race, or handicap. Course descriptions, counselor practices, the effect of prerequisites on enrollments, how the master schedule stifles or encourages nontraditional exploration, and many other access-related issues should be investigated and changed as needed.

Stage Two: Neutralizing Stereotypes and Bias in Existing Instructional Materials. In stage two, educators must review instructional materials, language usage, course objectives and activities, and Vocational Industrial Clubs of America (VICA) activities to determine if they are based on, rely on, or communicate stereotypes or traditional biases that "attribute behaviors, abilities, interests, values, and roles to a person or group of persons on the basis of sex, race, national origin, ancestry, creed, pregnancy, marital or parental status, sexual orientation, or physical, mental, emotional, or learning disability." (This definition of stereotyping comes from PI 9, Wis. Admin. Code, on pupil nondiscrimination.)

Stage Three: Revising an Existing Curriculum and Seeking to Attract and Meet the Needs of Both Male and Female Students. At this stage, educators should revise or supplement the curriculum to identify and meet the interests and needs of students who traditionally have not enrolled in a particular course. In the case of technology education, this is almost always females.

In reaching out to the nontraditional student, a troublesome paradox occurs. In order to attract a nontraditional student, educators need to appeal to the students' interests, which are frequently based on stereotypes and biases. This could reinforce and perpetuate the very stereotypes and biases that should be neutralized. For example, enrollment patterns show certain courses are perceived as more interesting for females, such as communications and graphic arts. Female participation in these courses, while encouraging from an equity point of view, may perpetuate old stereotypes and assumptions that other courses or skills are less interesting or less important and valuable, or "just for boys."

Specific strategies educators use in this phase include the following:

- using recruitment strategies aimed specifically at females, which increase their knowledge of technology and related occupations, opportunities, and skills;
- providing female role models in a variety of technology-related occupations from entry level to advanced positions;
- reviewing and changing the classroom environment to eliminate "male-only" images and promote messages that encourage female participation;
- supplementing the curriculum by addressing the changing roles of females and males in business and industry; and
- examining and neutralizing the forms of sex bias, especially communication/linguistic bias, by both teachers and students.

Stage Four: Reconstructing the Curriculum to Develop New Knowledge and Skills Based on Changing Roles, Responsibilities, and Conditions. This stage represents a conceptual shift or redefinition of each course, accomplished by including new instructional objectives and activities that embrace equity concepts and goals for both female and male students. Equity ideas and issues must be central to the reconstruction of the technology education curriculum described in this guide. While some courses outlined in this guide lend themselves more directly to discussing equity ideas, the entire program and curriculum must embrace and support new equity-related knowledge and skills.

Research on gender differences and similarities, on females, on males, on changing roles, and on equity has been conducted in the last 15 years. There is a growing body of literature on women as business leaders and entrepreneurs and on women in nontraditional jobs and careers. Students can benefit from exposure to and critical thinking about emerging technology issues created by changing social and economic conditions. These issues include

- the effects of sex-role stereotyping, bias, and discrimination (including sexual harassment) on individuals and on business and industry;
- changing roles of females and males in the world of work;
- comparable worth or value and wage equity or inequity associated with different jobs;
- emerging employee job benefits, such as employer-sponsored child care, child-bearing and child-rearing leave for males as well as females, and company transfer policies for two-wage-earner families;
- flex-time and job-sharing possibilities;
- the need for and results of affirmative action programs; and
- the impact of technology on various jobs and work procedures.

There are no actual models of the reconstructed curriculum proposed here on which to draw. Each technology educator will need to carefully examine the underlying assumptions of the current and projected curriculum. Some of the questions educators need to be concerned with include the following:

- Has the new body of knowledge on changing roles and gender-role stereotyping been incorporated into the technology education curriculum?
- Will the curriculum give students skills for the future, or will it establish expectations for the gender and occupational roles and responsibilities of a bygone era?
- Do instructional objectives facilitate critical thinking about the effect of major social and economic changes on the individual, the family, and business/industry?
- Will both female and male students truly be prepared for the dual roles of work of the family and work in the paid labor force?
- Will both female and male students have a greater respect for traditional "women's work"?
- Will both female and male students be prepared for the work partnerships of the future work world?
- Can trust be built between the sexes that will lead to greater teamwork and productivity?
- Will the new curriculum lead to greater understanding and appreciation of both women's and men's experiences, needs, perspectives, values, and futures in the rapidly changing world of work?

Student Equity-Related Competencies for Economic Self-Sufficiency and Equal Employment Opportunity

Student equity-related competencies are critical for the curriculum reconstruction described in the fourth stage of equity implementation. Such competencies are consistent with program improvement initiatives in vocational education and with the youth employment competencies established by Private Industry Councils (PIC) for Job Training Partnership Act (JTPA) programs.

Technology educators should review the equity-related competencies and consider how one or more might be included in courses and programs.

- General
  - Students will define and identify strategies to overcome role stereotyping, bias, and discrimination on the basis of race, sex, and handicapping conditions.
  - Students will be able to define and give examples of "dual discrimination."
  - Students will identify and analyze societal attitudes about men and women, sex-role stereotypes and bias, and forms of sex discrimination.
  - Students will be able to recognize and neutralize role stereotyping and bias in educational materials.
  - Students will demonstrate the use of sex-fair/inclusive language.
  - Students will develop a positive attitude about the abilities of both sexes, all racial and ethnic groups, and the handicapped.
- Work and family
  - Students will identify the responsibilities associated with dual work roles—paid work and work in the home and family.
  - Both male and female students will identify changes in family structure and responsibilities and the need to develop complex family-related skills.
- Labor force facts
  - Students will demonstrate knowledge of historical changes in the labor force participation of males and females.
  - Students will identify historical barriers to equal employment opportunity.

- Students will demonstrate knowledge that both men and women work for pay, in great numbers, for a long time, and out of economic necessity.
- Students will identify how role stereotyping, bias, and discrimination have contributed to occupational segregation in the U. S. labor market.
- Students will demonstrate knowledge of how traditional women's work has been undervalued and underpaid.

- Nontraditional occupations
  - Students will be able to define "nontraditional occupations" and will identify positive and negative aspects of employment in nontraditional careers.
  - Students will identify nontraditional jobs for females and males and the skills needed for those jobs.
  - Students will identify some of the issues that arise when women or men work in nontraditional jobs.
  - Students will identify coping strategies to survive and thrive in nontraditional jobs.
- Career development
  - Students will identify how sex-role stereotyping and bias may limit opportunities in planning their own future.
  - Male and female students will demonstrate awareness of the total range of career and occupational choices.
  - Students will formulate career development plans based on informed choice, labor market information, assessment of interests and skills, occupational exploration, and work experience, rather than on factors related to occupational stereotyping on the basis of sex, race, or handicapping conditions.
  - Both male and female students will identify how emerging technology is influencing jobs of the future.
  - Both male and female students will demonstrate experience in preparing for, adapting to, and influencing change in the work world.
  - Students will identify reasons why both males and females should acquire mathematics, science, computer, and technology skills.
  - Students will identify how sex stereotyping, bias, and discrimination may affect career planning, occupational exploration and preparation, employability and job seeking, job retention and advancement, job benefits and professional development, earnings, financial planning and management, and entrepreneurship.
  - Students will identify and discuss employment skills that both males and females will need to survive and thrive in the future economy, including skills in participative management, oral and written communication, assertiveness, teamwork, networking, cooperation, negotiation, flexibility, adapting, human relations, interpersonal relations, leadership, changing careers, coping with frequent and rapid change, and technological literacy.

The information and the checklists that follow are designed to help technology educators continue this task of examining curriculum, adjusting teaching practices, and achieving equity goals.

Forms of Bias in Curricular Materials and Classrooms

Six forms of bias are likely to be prevalent in curriculum materials, the classroom environment, and interactions.

Invisibility. Certain groups have been underrepresented in curriculum materials. The significant omission of women and minorities implies that they are of less value, importance, and significance in society. Females have formed "quiet" behavior patterns compared to the "active" role of males in the classroom. Teachers interact far more frequently with males; they reward males for academic work, punish them, talk to them, question them, and remember them in later years far more often than females. This invisibility has been underscored by discussion topics and by bulletin boards and displays that frequently omit skills of women and minorities.

Stereotyping. By assigning traditional and rigid roles or attributes to a group, instructional materials stereotype and limit the abilities and potential of that group. Stereotyping denies students knowledge of the diversity, complexity, and variation of any group of individuals.

Students who see themselves portrayed stereotypically may internalize these stereotypes and fail to develop their own unique abilities, interests, and full potential. Often, teachers have assumed that males share one set of abilities, interests, values, and roles, and females share a different set of these characteristics. These stereotyped expectations ignore individual differences, affect the teacher's behavior, and limit the full development of female and male students. Teachers often reward only males for active, assertive, dependable, and considerate behavior. When these stereotyped teacher expectations are reinforced by stereotyped models, pictures, and other displays, students receive additional messages of "appropriate" sex-role behavior. As a result, many students learn to limit their careers and capabilities in order to fit these stereotyped roles.

Imbalance/Selectivity. Textbooks perpetuate bias by presenting only one interpretation of an issue, situation, or group of people. An imbalanced account restricts students' knowledge of the varied perspectives that may apply to a situation.

Through selective presentations of materials, textbooks distort reality and ignore complex and differing viewpoints. As a result, millions of students may be presented limited perspectives on the contributions, struggles, and participation of females and minorities in our society.

The educational system has reflected an imbalance in compensatory educational programs. Special education programs have alleviated learning problems that tend to affect males but have generally ignored those that hamper females. Although there are special education programs for reading and emotional learning problems, there are few special programs in spatial relations and mathematics. Compensatory education programs have reflected a sex bias in selecting the types of learning problems to be recognized and remedied, and this imbalance has worked to the disadvantage of females.

Unreality. Frequently, textbooks present an unrealistic portrayal of history and contemporary life. They gloss over controversial topics and avoid discussions of discrimination and prejudice. Unrealistic coverage denies students the information needed to recognize, understand, and perhaps eliminate the problems that plague society. In spite of the many sources of sex bias in classroom interaction, most teachers and teacher educators are unaware of their roles in promoting educational inequality. To overcome this bias, educators need to be aware of their own patterns as they provide response opportunities, offer feedback, and interact on an informal level with personal regard for all others.

Fragmentation/Isolation. By separating issues related to minorities and women from the main body of the text, instructional materials imply that these issues are less important and not a part of the cultural mainstream. By arbitrarily separating females and males in classroom procedures—such as lining up, forming work groups, and organizing recreational activities—teachers promote the fragmentation and artificial isolation of the sexes. Purposeless separation is a divisive influence and works against the goal of sexual equality. When represented in the physical environment of the classroom, on bulletin boards, and in other displays, the roles and contributions of women have been presented separately and secondly as though the female role is only a corollary to the mainstream of human experience.

Linguistic Bias. Curriculum materials often reflect the discriminatory nature of the language. Masculine terms and pronouns ranging from "our forefathers" to the generic "he" deny women's participation in our society. Occupations are given masculine labels, such as "mailman," denying the presence of women workers in these fields. Imbalance of word order and lack of parallel terms referring to females and males are also forms of linguistic bias. The same forms of language bias present in instructional materials may also emerge in the language of the classroom. Sex-biased words, such as "mankind" and "salesman," and the constant reliance on the male pronoun "he" to refer to both males and females are examples of sexist language patterns that belittle the role and importance of females. As in the other cases of bias, physical displays in the classroom may also reflect biased language.

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Chart 1
Technology Education Course Enrollments

Grades 9-12, 1984-85

Course Composition by Sex

	Males		Females		
	Number	Percent	Number	Percent	Total
American Industry	1,433	91.6	131	8.4	1,564
Architectural Design	5,946	90.4	633	9.6	6,579
Auto Repair and Service	10,849	91.1	1,061	8.9	11,910
Communications	2,726	78.9	730	21.1	3,456
Construction	5,511	93.3	396	6.7	5,907
Electricity/Electronics	9,925	96.3	378	3.7	10,303
Graphic Arts	6,529	72.3	2,501	27.7	9,030
Industrial Co-op	1,051	88.8	133	11.2	1,184
Industrial Enterprise	1,215	91.0	120	9.0	1,335
Industriology	2,890	87.9	396	12.1	3,286
Manufacturing	1,414	94.3	86	5.7	1,500
Materials Processing	3,456	95.3	172	4.7	3,628
Mechanical Design	14,285	91.2	1,375	8.8	15,660
Metal Processing	23,114	96.6	823	3.4	23,937
Plastic Processing	2,952	93.3	211	6.7	3,163
Power/Energy	6,787	96.9	220	3.1	7,007
Research and Development	864	88.7	110	11.3	974
Small Engine Repair	8,583	95.3	421	4.7	9,004
Wood Processing	121,027	98.6	1,736	1.4	122,763

Based on Wisconsin Department of Public Instruction's 1984-85 Statewide Curriculum Survey; compiled March 1987.

Chart 2
Technology Education Course Enrollments

Grades 9-12, 1984-85

Percent of Female Enrollment
By Course—Highest to Lowest

	Percent
Graphic Arts	27.7
Communications	21.1
Industriology	12.1
Research and Development	11.3
Industrial Co-op	11.2
Architectural Design	9.6
Auto Repair and Service	8.9
Industrial Enterprise	9.0
Mechanical Design	8.8
American Industry	8.4
Construction	6.7
Plastic Processing	6.7
Manufacturing	5.7
Materials Processing	4.7
Small Engine Repair	4.7
Electricity/Electronics	3.7
Metal Processing	3.4
Power/Energy	3.1
Wood Processing	1.4

Based on Wisconsin Department of Public Instruction's 1984-85 Statewide Curriculum Survey; compiled March 1987.

Chart 3
VEDS IPC* 1984-85 Enrollment Data

	Males		Females		
	Number	Percent	Number	Percent	Total
Air Conditioning	24	100.0	0	0	24
Appliance Repair	28	100.0	0	0	28
Automotive	2,093	97.8	46	2.2	2,139
Aviation	22	100.0	0	0	22
Business Machine Maintenance	1	100.0	0	0	1
Commerical Arts	9	81.8	2	18.2	11
Commercial Photography	1	50.0	1	50.0	2
Construction & Maintenance	1,076	98.3	19	1.7	1,095
Diesel Mechanics	84	98.8	1	1.2	85
Drafting Occupations	648	90.6	67	9.4	715
Electrical Occupations	99	97.1	3	2.9	102
Electronics Occupations	324	95.9	14	4.1	338
Graphic Arts	505	71.2	204	28.8	709
Metalworking	1,165	97.9	25	2.1	1,190
Plastics	22	71.0	9	29.0	31
Public Service	11	78.6	3	21.4	14
Small Engine Repair	52	94.5	3	5.5	55
Woodworking Occupations	216	98.6	3	1.4	219
Other Trades	66	90.4	7	9.6	73
Total	6,446	94.1	407	5.9	6,853

Based on Wisconsin Department of Public Instruction's Vocational Education Data System (VEDS) 1984-85; compiled March 1987.

* Instructional Program Component—these figures represent advanced students with a professed career goal in these areas.

Chart 4
Profile of an Equitable Classroom*

Physical Environment	
Ideal	The teacher visually portrays females and males in both traditional and nontraditional roles and includes representatives of various races and cultures in pictorial displays.
Acceptable	The teacher provides neutral images in pictorial displays.
Unacceptable	The teacher visually portrays people only in roles traditional for their race, sex, or culture. The teacher portrays only one sex, race, or culture in visual displays. The teacher's visual displays portray sex, race, or ethnic stereotypes.
Curriculum	
Ideal	The teacher's classroom activities are multicultural and sex-fair. The teacher includes classroom lessons to increase awareness and counter past effects of bias and discrimination.
Acceptable	The teacher's classroom activities are multicultural and sex-fair.
Unacceptable	The teacher does not include the contributions of women or minorities. The teacher presents stereotyped views of groups of people.
Language	
Ideal	The teacher uses inclusionary terms for people in all written and oral communication. The teacher works with students to help them develop inclusionary language forms and encourages all students to use those terms in their own communications. The teacher discusses the negative impact of using derogatory terms in reference to race, sex, or ethnic groups.
Acceptable	The teacher uses inclusionary terms for people in all written and oral communication.
Unacceptable	The teacher uses derogatory terms in reference to any race, sex, or ethnic group. The teacher repeatedly uses sex-limited language. The teacher repeatedly mispronounces any student's name. The teacher allows students to use derogatory terms in reference to any race, sex, or ethnic group.

*Adapted from Leslie F. Hergert and Raymond M. Rose, *Profile of an Equitable Classroom* (Andover, MA: The NETWORK, Inc., 1984). Reprinted with permission.

Chart 4
Profile of an Equitable Classroom (cont.)

Active Teacher Attention	
Ideal	The teacher provides the same amount of teaching attention to all students, with individual differences based on their need and style. The teacher directs classroom discussion to allow all students to participate.
Unacceptable	The teacher provides students with different amounts of attention based on their race, sex, or national origin. The teacher allows a student or group of students to dominate the class.
Behavior Management	
Ideal	The teacher informs students in advance of acceptable and unacceptable behavior and the consequences of their behavior. The teacher reprimands all students equally for infractions of classroom or school rules. The teacher praises all students equally for good behavior.
Unacceptable	The teacher reprimands students differently for behavioral infractions based on their race, sex, or national origin. The teacher attributes stereotyped characteristics to a sex, race, or national origin group.
Academic Evaluation	
Ideal	The teacher praises students for the intellectual quality of their work—regardless of their race, sex, or national origin—from a set of criteria that has been announced to the students. The teacher analyzes interactions with students for differential patterns and takes actions to counteract and balance differences.
Unacceptable	The teacher uses a different set of criteria for evaluating the academic work of students based on their race, sex, or national origin. The teacher evaluates females and males differently for the same performance.

Classroom Integration	
Ideal	The teacher promotes cooperation and integration of students through activities that help students of different sexes, races, and ethnic groups to work together more effectively. The teacher structures classroom activities to develop and exercise leadership skills among a variety of students.
Acceptable	The teacher assigns classroom seating patterns, project groups, and other structured activities to integrate students by race, sex, and ethnic group.
Unacceptable	The teacher groups students for any activity by race, sex, or ethnicity. The teacher allows segregated patterns to exist by allowing students to group themselves. The teacher assigns classroom tasks on the basis of a student's race, sex, or ethnicity. The teacher structures classroom tasks to encourage competition among different sexes, races, or ethnic groups.

Checklist 1
Equity Standards for Technology Education*

	Yes	No
Philosophy		
1. The philosophy identifies the needs, abilities, and interests of all learners, regardless of race, sex, creed, national origin, or handicapping conditions.	☐	☐
Student Populations Served		
2. Females, as well as males, are encouraged to enroll in technology education courses.	☐	☐
3. Technology education activities are provided for all students on a sex-fair basis.	☐	☐
Instructional Staff		
4. The technology education teacher is prepared, through preservice/inservice education, to eliminate sex bias and sex-role stereotyping.	☐	☐
Administration and Supervision		
5. Demographic data about all technology education students are available by grade level and by course, including but not limited to course enrollments by racial and ethnic categories, by sex, and by type and number of students with special needs	☐	☐
Support System		
6. A technology education advisory committee is established that has representation of both sexes and of the racial and ethnic minorities found in the program areas, schools, community, or region that the local advisory committee serves.	☐	☐
7. Lavatory facilities for both sexes are provided near or in the technology education laboratory.	☐	☐
8. Books and other instructional materials contain sex-fair language and images and provide a wide range of role options.	☐	☐
Instructional Strategies		
9. Instructional methods utilized are based upon individual student needs rather than upon sex of the students.	☐	☐

*Adapted from Wisconsin Department of Public Instruction, *Sex Equity Guide for Technology Education Programs* (Madison, WI: Department of Public Instruction, 1982); and W.E. Dugger et al., *Report of Survey Data: Standards for Industrial Arts Programs* (Blacksburg, VA: Virginia Polytechnic Institute and State University, 1981).

Checklist 2
Sex Equity Self-Assessment*

Directions: Complete this checklist and consider specific areas for improvement.

	Always	Often	Sometimes	Never	N/A**
Expectations. I expect the same achievement and behavior from males and females.	☐	☐	☐	☐	☐
Duties. I assign females and males duties and responsibilities on the basis of ability rather than sex.	☐	☐	☐	☐	☐
Language. I use nonsexist language; for example, I do not refer to all employers or office managers as "he" or all administrative assistants as "she."	☐	☐	☐	☐	☐
Attitude. I take the idea of equality seriously; I do not "put down" males or females or joke about their abilities, roles, or ethnic backgrounds.	☐	☐	☐	☐	☐
Environment. All bulletin boards and visual materials are nonsexist and nonracist, showing women and men in a variety of roles that reflect the many interests of females and males.	☐	☐	☐	☐	☐
Curriculum. I ensure that the curriculum is nonsexist; for example, I plan a curriculum that					
• addresses the needs and interests of both females and males.	☐	☐	☐	☐	☐
• recognizes the contributions of both sexes.	☐	☐	☐	☐	☐
• provides for the equal treatment of both sexes in all subject areas.	☐	☐	☐	☐	☐
• helps males and females explore the wide range of roles and career options available.	☐	☐	☐	☐	☐

*Adapted from Marilyn Calabrese, *Becoming Sex Fair: The Tredyffrin/Easttown Program* (Newton, MA: WEEA Publishing Center).

**N/A = Not Applicable

Checklist 3
Sex Equity in Curriculum Materials

Directions: Use this checklist to determine the degree to which sex bias is present in curriculum materials. These questions apply to the language and visuals used in both print and nonprint materials. If you answer "no" in any category, the material is biased; you should replace the material if possible or develop handouts to supplement the material and discuss it with your students. Before purchasing new material, use this checklist to determine the appropriateness of the purchase.

		Yes	No	N/A*
1.	Are occupations shown as open to all?	☐	☐	☐
2.	Are sex-free titles used, as indicated in the current *Dictionary of Occupational Titles*?	☐	☐	☐
3.	Are females and males depicted in occupations currently dominated by the other sex (nontraditional occupations)?	☐	☐	☐
4.	Are females and males portrayed in both active and passive roles throughout in approximately the same numbers?	☐	☐	☐
5.	Are various races and ethnic groups presented throughout in a balanced or representative fashion?	☐	☐	☐
6.	Are females and males shown to have all human traits?	☐	☐	☐
7.	Do females and males appear in approximately the same number throughout the materials?	☐	☐	☐
8.	Are females and males pictured performing a variety of home tasks that are not necessarily traditional for their sex?	☐	☐	☐
9.	Are gender-free, plural pronouns used? Is there an equal balance of gender-specific, singular pronouns? Are gender-free nouns substituted for gender-specific pronouns?	☐	☐	☐
10.	Are both minority and nonminority females and males pictured equally in varied levels of occupational status and responsibility?	☐	☐	☐
11.	Do illustrations of people include a variety of body types along with evidence of handicaps/disabilities?	☐	☐	☐

*N/A = Not Applicable

		Yes	No	N/A*
12.	Is written reference made to physical appearance only when there is a purpose for the reference?	☐	☐	☐
13.	After reviewing this material, do you come away with a sense that females and males of various ethnic and racial backgrounds, some with handicaps, are involved in a variety of occupations, with a variety of responsibilities, and that opportunities are not limited on the basis of gender, race, or handicaps?	☐	☐	☐
14.	Comments/recommendations.			

*N/A = Not Applicable

Checklist 4
Evaluation of a Sex-Fair Classroom Setting*

Directions: Research has shown nonverbal messages carry a stronger impact than verbal messages. Such things as recruitment methods, teacher behaviors, and visuals used to support instruction tell students how they are valued in a class or program. Use this checklist to assess the degree to which your classroom setting promotes sex equity.

		Yes	No
1.	Do units of instruction and activities currently include both sexes?	☐	☐
2.	Are teaching materials and handouts free of sex bias and sex-role stereotyping?	☐	☐
3.	Are teaching methods free of sex bias?	☐	☐
4.	Are students of both sexes actively encouraged to enroll?	☐	☐
5.	Do teaching examples relate to both sexes?	☐	☐
6.	Are bulletin boards appropriate for students of both sexes?	☐	☐
7.	Are role models available for both sexes?	☐	☐
8.	Is nonverbal behavior free of sex bias?	☐	☐
9.	Do students have equal opportunities to do tasks?	☐	☐
10.	Do counselors and other teachers view your program as suitable for both females and males?	☐	☐

*Adapted from Donna Koppi Boben, *Guidelines for Equity Issues in Technology Education* (Reston, VA: International Technology Education Association, 1985).

Checklist 5
Evaluation of Sex-Fair Teaching Behavior

Directions: As a technology education teacher, you serve as a model for students. You can significantly affect students' attitudes and behaviors. Are you satisfied with the model you present? Is that model free of sex-stereotyped behaviors?

In my teaching, I	Always	Usually	Never
1. provide the same course content for students of both sexes.	☐	☐	☐
2. provide the same kind of learning activities and projects for all students rather than providing them based on gender stereotypes.	☐	☐	☐
3. allow all students equal access to machines and equipment; the same standards of use apply to students of both sexes.	☐	☐	☐
4. intervene when males do activities or use machines and females watch (or vice versa).	☐	☐	☐
5. encourage all students to be equally considerate and courteous to others, instead of males being "chivalrous" and females being "ladylike."	☐	☐	☐
6. administer the same reprimands or disciplinary actions to students of both sexes for misbehavior.	☐	☐	☐
7. use gender-free terms and occupational titles rather than sex-specific ones ("human" or "person" instead of "mankind" or "man").	☐	☐	☐
8. avoid stereotypic phrases such as "boys will be boys" and "girls should act like ladies."	☐	☐	☐
9. give equal attention to students of both sexes rather than more support for females and more criticism for males.	☐	☐	☐
10. establish the same safety and dress requirements for all students.	☐	☐	☐

Checklist 5
Evaluation of Sex-Fair Teaching Behavior (cont.)

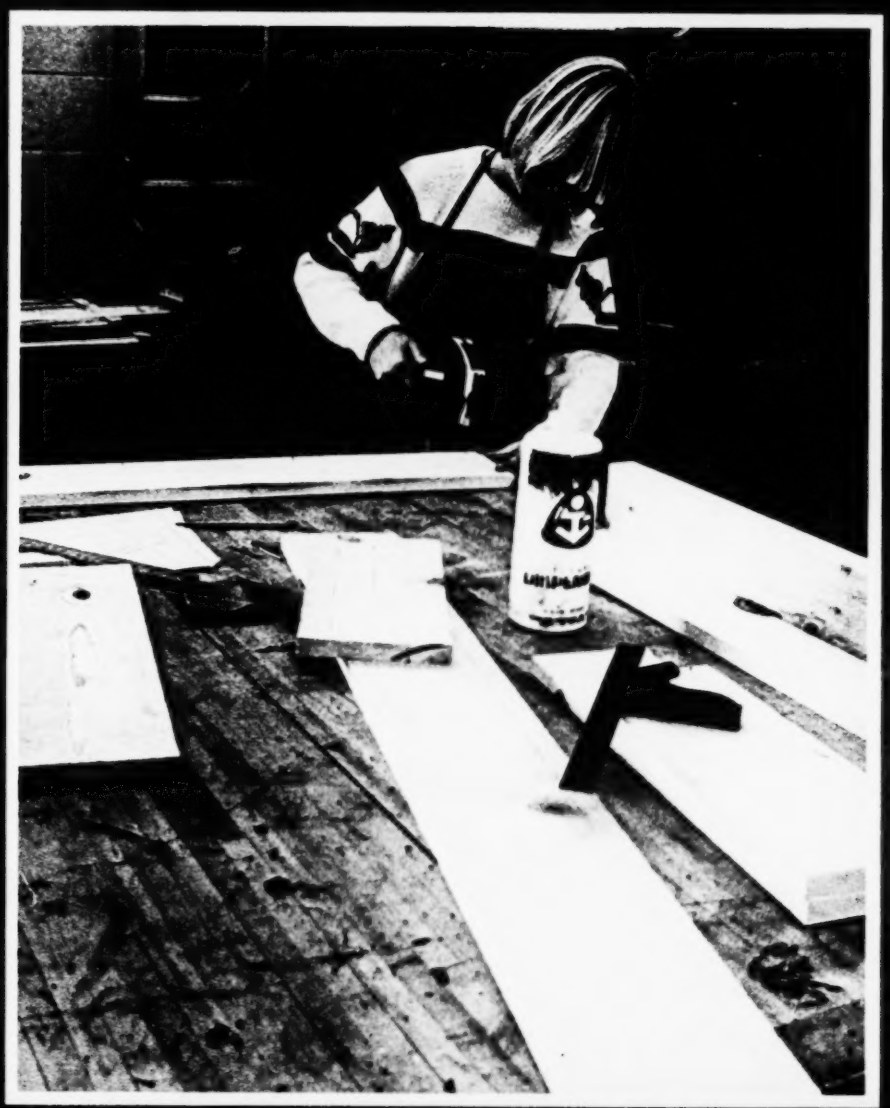
		Always	Usually	Never
11.	establish and apply the same grading system to students of both sexes.	☐	☐	☐
12.	act in a way that allows or encourages both sexes to be equally capable in this course.	☐	☐	☐
13.	incorporate the topics of sex discrimination, stereotyping, and bias into regular course content and discussions whenever possible.	☐	☐	☐
14.	provide information to students about expanding occupational and family activities for both sexes in areas that have traditionally been considered appropriate for only one sex.	☐	☐	☐
15.	assist both female and male students in recognizing that their adult roles will probably include paid work, parenting, and homemaking.	☐	☐	☐
16.	involve students in identifying examples of sex discrimination, stereotyping, and bias in textbooks, curriculum, media, and other course-related materials, such as technology-related journals, job descriptions, and advertising.	☐	☐	☐
17.	help students identify sex discrimination and stereotyping in their education and personal lives and brainstorm options for dealing with these situations.	☐	☐	☐
18.	request anonymous student evaluations concerning any sex discrimination, stereotyping, or bias they may feel exists in the classroom (Do you think I favor boys over girls or treat girls or boys as if they are not capable?).	☐	☐	☐
19.	encourage students to correct me if I use sex-specific terms or sexist generalizations (telling a female she did a "man-sized" job).	☐	☐	☐

Checklist 6
Evaluation of Sex-Fair Language Usage

Directions: Using this checklist, assess the degree to which your personal language usage is sex-fair. Also use this checklist to assess the sex-fairness of language in instructional materials.

		Yes	No
1.	Are both pronouns (*she/he* and *him/her*) or plural pronouns used whenever sex is unspecified?	☐	☐
2.	Do pronouns and their antecedents apply to both sexes when general references are made to careers and occupations ("A computer programmer is a skilled person. He/she is required to perform a number of tasks.")?	☐	☐
3.	Are universal male terms avoided when the career or occupation is meant to include both sexes (sales *agent* instead of sales*man*, business*person* instead of business*man*)?	☐	☐
4.	When referring to both sexes, are the female and male terms used alternately throughout the text (*girls and boys, he/she*)?	☐	☐
5.	Do you avoid unnecessary clarification when men and women hold nontraditional jobs ("*male* secretary," "*woman* business owner")?	☐	☐
6.	Are occupational titles that use "man" as the suffix avoided (chair*man*, business*man*, sales*man*)?	☐	☐
7.	Are parallel terms used in referring to females and males ("Dr. Jones and Ms. Smith" versus "Dr. Jones and the secretary, Nancy")?	☐	☐
8.	Are the words "women" and "female" replaced by demeaning synonyms like *girls, fair sex, chicks*, or *ladies*?	☐	☐
9.	Are women described in terms of their appearance or marital status, while men are described in terms of accomplishments or titles?	☐	☐
10.	Are women consistently presented as either dependent on or subordinate to men?	☐	☐
11.	Do materials use sex-fair language and then slip into the use of the generic *he*?	☐	☐
12.	Are quotations, references, and supplemental study materials authored by women as well as men?	☐	☐

B



Communications

1. Graphic Communications

1.1 Printing

1.1.1 Type

1.1.1.1 Relief
1.1.1.2 Screen
1.1.1.3 Lithography
1.1.1.4 Gravure
1.1.1.5 Electrostatic
1.1.1.6 Ink Jet

1.1.2 Process

1.1.2.1 Image Design
1.1.2.2 Image Assembly
1.1.2.3 Image Conversion
1.1.2.4 Image Carrier Preparation
1.1.2.5 Image Transfer
1.1.2.6 Finishing

1.1.3 Products

1.1.3.1 Material
1.1.3.1.1 Paper
1.1.3.1.2 Non-paper

1.1.3.2 Use
1.1.3.2.1 Consumable
1.1.3.2.2 Permanent

1.1.4 Impact (Domestic/Global)

1.1.4.1 Economic
1.1.4.2 Political
1.1.4.3 Values/Attitudes
1.1.4.4 Environment

1.2 Photography

1.2.1 Type

1.2.1.1 Film Imaging
1.2.1.1.1 Silver Base
1.2.1.1.2 Non-Silver Base
1.2.1.2 Electronic Imaging

1.2.2 Process

1.2.2.1 Image Design
1.2.2.2 Image Assembly
1.2.2.3 Image Exposure
1.2.2.4 Image Conversion
1.2.2.5 Image Reproduction

1.2.3 Products

1.2.3.1 Film
1.2.3.2 Print
1.2.3.3 Video (?)

1.2.4 Impact (Domestic/Global)

1.2.4.1 Economic
1.2.4.2 Political
1.2.4.3 Values/Attitudes
1.2.4.4 Environment
1.2.4.5 Aesthetic

2. Electronic Communications

2.1 Telecommunications

2.1.1 Types

2.1.1.1 One-way Communications
2.1.1.1.1 Radio
2.1.1.1.2 Television
2.1.1.2 Two-way Communications
2.1.1.2.1 Radio
2.1.1.2.2 Radar

2.1.2 Process

2.1.2.1 Designing
2.1.2.2 Encoding

*This entire appendix is reprinted from Thomas Wright and Leonard Sterry (co-directors), *Industry and Technology Education: A Guide for Curriculum Designers, Implementors, and Teachers* (Lansing, IL: The Technical Foundation of America), pp. 214-252. The "Technology Education Content" chart, given as Figure 3 in Section 1 and reproduced on the colored wall chart, is derived from these taxonomies, with minor language changes and condensing.

2.1.2.3 Transmitting
2.1.2.4 Storing/Retrieving
2.1.2.5 Receiving
2.1.2.6 Decoding

2.1.3 Product

2.1.3.1 Entertainment
2.1.3.2 Information/Data
2.1.3.3 Detection

2.1.4 Impact (Domestic/Global)

2.1.4.1 Economic
2.1.4.2 Political
2.1.4.3 Values/Attitudes
2.1.4.4 Environment

2.2 Conductor

2.2.1 Types

2.2.1.1 One Way
2.2.1.1.1 Voice (Public Address System)
2.2.1.1.2 Data

2.2.1.2 Two Way
2.2.1.2.1 Voice (Telephone)
2.2.1.2.2 Data
2.2.1.2.2.1 Telegraph
2.2.1.2.2.2 Telephone

2.2.2 Process

2.2.2.1 Designing
2.2.2.2 Encoding
2.2.2.3 Transmitting
2.2.2.4 Storing/Retrieving
2.2.2.5 Receiving
2.2.2.6 Decoding

2.2.3 Product

2.2.3.1 Entertainment
2.2.3.2 Information/Data
2.2.3.3 Detection

2.2.4 Impacts (Domestic/Global)

2.2.4.1 Economic
2.2.4.2 Political
2.2.4.3 Values/Attitudes
2.2.4.4 Environment

2.3 Computer Systems

2.3.1 Types

2.3.1.1 Analog
2.3.1.2 Digital

2.3.2 Process

2.3.2.1 Input
2.3.2.2 Storage
2.3.2.3 Processing
2.3.2.4 Output

2.3.3 Interface

2.3.3.1 Human
2.3.3.2 Machine/Equipment

2.3.4 Products

2.3.4.1 Entertainment
2.3.4.2 Computations
2.3.4.3 Detection/Control
2.3.4.4 Data Exchange

2.3.5 Impacts

2.3.5.1 Economic
2.3.5.2 Political
2.3.5.3 Values/Attitudes
2.3.5.4 Environment

3. Light Communication

3.1 Interactive

3.1.1 Light Sources

3.1.1.1 Coherent
3.1.1.2 Non-coherent

3.1.2 Processes

3.1.2.1 Designing
3.1.2.2 Encoding
3.1.2.3 Transmitting
3.1.2.4 Receiving
3.1.2.5 Decoding

3.1.3 Products

3.1.3.1 Entertainment
3.1.3.2 Information/Data
3.1.3.3 Detection

3.1.4 Impacts

3.1.4.1 Economic
3.1.4.2 Political
3.1.4.3 Values/Attitudes
3.1.4.4 Environment

3.2 Passive

3.2.1 Light Sources

3.2.1.1 Coherent
3.2.1.2 Non-coherent

3.2.2 Process

3.2.2.1 Designing
3.2.2.2 Encoding
3.2.2.3 Transmitting
3.2.2.4 Receiving
3.2.2.5 Decoding

3.2.3 Products

3.2.3.1 Entertainment
3.2.3.2 Information/Data
3.2.3.3 Detection

3.2.4 Impacts

3.2.4.1 Economic
3.2.4.2 Political
3.2.4.3 Values/Attitudes
3.2.4.4 Environment

4. Acoustic Communications

4.1 Sonic Detection

4.1.1 Transmission Media

4.1.1.1 Gas
4.1.1.2 Liquid
4.1.1.3 Solid

4.1.2 Process

4.1.2.1 Modulation
4.1.2.2 Transmitting
4.1.2.3 Receiving
4.1.2.4 Decoding

4.1.3 Products

4.1.3.1 Information/Data
4.1.3.2 Detection/Control

4.1.4 Impacts

4.1.4.1 Economic
4.1.4.2 Political
4.1.4.3 Values/Attitudes
4.1.4.4 Environment

4.2 Storage/Retreival

4.2.1 Types

4.2.1.1 Magnetic
4.2.1.2 Mechanical

4.2.2 Process

4.2.2.1 Encoding
4.2.2.2 Storing
4.2.2.3 Retrieving
4.2.2.4 Decoding

4.2.3 Products

4.2.3.1 Information/Data
4.2.3.2 Entertainment

4.2.4 Impacts

4.2.4.1 Economic
4.2.4.2 Political
4.2.4.3 Values/Attitudes
4.2.4.4 Environment

1. Construction Managed Activities

1.1 Research and Development

1.1.1 Initiating the Project

1.1.1.1 Formulating
- **1.1.1.1.1 Determining Objectives**
  - *1.1.1.1.1.1 Stating Goals*
  - *1.1.1.1.1.2 Consulting*
  - *1.1.1.1.1.3 Establishing Project Criteria*
  - *1.1.1.1.1.4 Evaluating*
  - *1.1.1.1.1.5 Describing Objectives*
- **1.1.1.1.2 Researching**
  - *1.1.1.1.2.1 Locating Data*
  - *1.1.1.1.2.2 Retrieving Data*
  - *1.1.1.1.2.3 Describing Data*
    - 1.1.1.1.2.3.1 Drawing
    - 1.1.1.1.2.3.2 Reporting
    - 1.1.1.1.2.3.3 Classifying/Categorizing
    - 1.1.1.1.2.3.4 Defining
  - *1.1.1.1.2.4 Evaluating Data*
    - 1.1.1.1.2.4.1 Comparing
    - 1.1.1.1.2.4.2 Contrasting
    - 1.1.1.1.2.4.3 Measuring Against Criteria
    - 1.1.1.1.2.4.4 Rating
  - *1.1.1.1.2.5 Forecasting*

1.1.1.2 Administering the Project
- **1.1.1.2.1 Directing**
  - *1.1.1.2.1.1 Coordinating*
  - *1.1.1.2.1.2 Assigning*
  - *1.1.1.2.1.3 Supervising*
  - *1.1.1.2.1.4 Inspecting*
- **1.1.1.2.2 Authorizing**
  - *1.1.1.2.2.1 Verifying*
  - *1.1.1.2.2.2 Certifying*
  - *1.1.1.2.2.3 Approving*
  - *1.1.1.2.2.4 Redefining*

1.1.1.3 Project Programming
- **1.1.1.3.1 Evaluating**
  - *1.1.1.3.1.1 Analyzing Data*
  - *1.1.1.3.1.2 Comparing*
  - *1.1.1.3.1.3 Contrasting*
- **1.1.1.3.2 Selecting**
  - *1.1.1.3.2.1 Examining*
  - *1.1.1.3.2.2 Eliminating*
  - *1.1.1.3.2.3 Adapting*
  - *1.1.1.3.2.4 Adopting*
- **1.1.1.3.3 Presenting**
  - *1.1.1.3.3.1 Scheduling*
  - *1.1.1.3.3.2 Diagraming*
  - *1.1.1.3.3.3 Reporting*
  - *1.1.1.3.3.4 Demonstrating*
  - *1.1.1.3.3.5 Summarizing*

1.1.2 Developing the Project

1.1.2.1 Designing
- **1.1.2.1.1 Evaluating Concepts**
  - *1.1.2.1.1.1 Evaluating the Program*
  - *1.1.2.1.1.2 Determining Functional Relationships*
- **1.1.2.1.2 Postulating Solutions**
  - *1.1.2.1.2.1 Scaling Functional Relationships*
  - *1.1.2.1.2.2 Presenting Solutions*
- **1.1.2.1.3 Selecting a Solution**
  - *1.1.2.1.3.1 Analyzing Alternative Solutions*
  - *1.1.2.1.3.2 Appraising Alternative Solutions*
  - *1.1.2.1.3.3 Evaluating Alternative Solutions*

1.1.2.2. Engineering
- **1.1.2.2.1 Interpreting Drawings and Reports**
- **1.1.2.2.2 Establishing Detail Design Criteria and Standards**
- **1.1.2.2.3 Analyzing Problems–Proposal**
  - *1.1.2.2.3.1 Grouping*
  - *1.1.2.2.3.2 Classifying*
  - *1.1.2.2.3.3 Identifying*
- **1.1.2.2.4 Estimating Sizes–Capacities**
  - *1.1.2.2.4.1 Referring (past experience)*
  - *1.1.2.2.4.2 Comparing*
  - *1.1.2.2.4.3 Approximating*
- **1.1.2.2.5 Detail Designing**
  - *1.1.2.2.5.1 Standardizing Components/Elements*
  - *1.1.2.2.5.2 Computing*
    - 1.1.2.2.5.2.1 Calculating
    - 1.1.2.2.5.2.2 Calibrating
    - 1.1.2.2.5.2.3 Appraising
  - *1.1.2.2.5.3 Experimenting*
    - 1.1.2.2.5.3.1 Modeling
    - 1.1.2.2.5.3.2 Building Prototypes
    - 1.1.2.2.5.3.3 Testing
  - *1.1.2.2.5.4 Preparing Working Drawings*
    - 1.1.2.2.5.4.1 Scaling
    - 1.1.2.2.5.4.2 Dimensioning
    - 1.1.2.2.5.4.3 Notating
    - 1.1.2.2.5.4.4 Referencing and Titles
  - *1.1.2.2.5.5 Securing Approval*
    - 1.1.2.2.5.5.1 Inspecting
    - 1.1.2.2.5.5.2 Authorizing

1.1.2.2.6 Specifying
1.1.2.2.6.1 Preparing Outline Specifications
1.1.2.2.6.2 Drafting Final Specifications

1.1.3 Implementing

1.1.3.1 Contracting
1.1.3.2 Construction Programming
1.1.3.3 Procuring
1.1.3.4 Supervising Construction

1.2 Marketing

1.2.1 Analyzing the Market

1.2.1.1 Studying National and Local Levels of Economic Activity
1.2.1.2 Detecting Employment and Income Trends
1.2.1.3 Ascertaining Population Patterns and Trends
1.2.1.4 Studying the Cost and Availability of Mortgage Funds
1.2.1.5 Synthesizing the Demand for Particular Types of Construction Projects
1.2.1.6 Detecting Client Needs, Wants, and Spending Patterns
1.2.1.7 Reviewing Government Regulations and Legal Restrictions

1.2.2 Establishing Marketing Strategy

1.2.2.1 Selecting Products
1.2.2.2 Selecting Target Clients
1.2.2.3 Pricing Project(s)
1.2.2.4 Timing Entry Into Market

1.2.3 Promoting

1.2.3.1 Advertising
1.2.3.2 Showing Property
1.2.3.3 Qualifying Potential Buyers
1.2.3.4 Pursuing Potential Buyers

1.2.4 Closing the Sale

1.2.4.1 Drawing Up a Sales Agreement
1.2.4.2 Complying with Terms of Sales Agreement
1.2.4.3 Transferring Ownership

1.3 Industrial Relations

1.3.1 Hiring

1.3.1.1 Recruiting
1.3.1.2 Selecting
1.3.1.3 Inducting

1.3.2 Training

1.3.2.1 On-the-Job Training
1.3.2.2 Other Training

1.3.3 Providing Benefits

1.3.3.1 Paying Wages and Salaries
1.3.3.2 Paying Fringe Benefits
1.3.3.3 Providing Physical Environment
1.3.3.4 Providing Social Environment

1.3.4 Providing Career Options

1.3.4.1 Promoting
1.3.4.2 Demoting
1.3.4.3 Transferring
1.3.4.4 Discharging
1.3.4.5 Retiring

1.4 Financing

1.4.1 Appraising Property

1.4.1.1 Inspecting
1.4.1.2 Recording
1.4.1.3 Describing
1.4.1.4 Analyzing
1.4.1.5 Correlating
1.4.1.6 Estimating
1.4.1.7 Reporting
1.4.1.8 Certifying

1.4.2 Estimating Probable Costs (land and construction)

1.4.2.1 Measuring
1.4.2.2 Pricing
1.4.2.3 Calculating
1.4.2.4 Projecting
1.4.2.5 Accounting
1.4.2.6 Comparing
1.4.2.7 Evaluating

1.4.3 Funding

1.4.3.1 Backing
1.4.3.2 Capitalizing
1.4.3.3 Mortgaging
1.4.3.4 Borrowing
1.4.3.5 Selling
1.4.3.6 Purchasing
1.4.3.7 Amortizing
1.4.3.8 Incorporating
1.4.3.9 Matching

1.4.4 Documenting

1.4.4.1 Describing
1.4.4.2 Contracting
1.4.4.3 Floating
1.4.4.4 Legalizing

1.4.5 Budgeting

1.4.5.1 Allocating
1.4.5.2 Timing

1.4.6 Making Payments

2. Construction Production Processes

2.1 Preparing the Site

2.1.1 Clearing the Site

2.1.1.1 Providing Temporary Access and Protection
2.1.1.1.1 Protecting Personnel and Property
2.1.1.1.1.1 Posting
2.1.1.1.1.2 Fencing
2.1.1.1.1.3 Banking
2.1.1.1.1.4 Ditching
2.1.1.1.1.5 Bracing and Shoring
2.1.1.1.1.6 Weatherproofing
2.1.1.1.2 Laying Roads and Walkways
2.1.1.1.2.1 Grading
2.1.1.1.2.2 Bridging
2.1.1.1.2.3 Compacting
2.1.1.1.2.4 Surfacing
2.1.1.1.2.5 Rolling

2.1.1.2 Reducing Obstacles
2.1.1.2.1 Demolishing and Salvaging
2.1.1.2.1.1 Disassembling
2.1.1.2.1.2 Wrecking
2.1.1.2.1.3 Bulldozing
2.1.1.2.1.4 Cutting
2.1.1.2.1.5 Chaining
2.1.1.2.1.6 Blasting
2.1.1.2.1.7 Burning
2.1.1.2.2 Extracting
2.1.1.2.2.1 Draining
2.1.1.2.2.2 Rerouting
2.1.1.2.2.3 Digging
2.1.1.2.2.4 Ripping
2.1.1.2.2.5 Scraping
2.1.1.2.2.6 Grubbing

2.1.1.3 Handling Materials
2.1.1.3.1 Transferring Materials
2.1.1.3.1.1 Loading and Hauling
2.1.1.3.1.2 Dragging
2.1.1.3.1.3 Pushing
2.1.1.3.1.4 Pumping
2.1.1.3.2 Disposing of Materials On-site
2.1.1.3.2.1 Stockpiling-Stacking
2.1.1.3.2.2 Burying
2.1.1.3.2.3 Burning
2.1.1.3.2.4 Spreading

2.1.2 Setting up Temporary Facilities

2.1.2.1 Establishing Temporary Shelters
2.1.2.1.1 Transporting Temporary Shelters
2.1.2.1.1.1 Hauling
2.1.2.1.1.2 Towing
2.1.2.1.2 Setting Up Temporary Shelters
2.1.2.1.2.1 Parking
2.1.2.1.2.2 Fabricating

2.1.2.2 Providing Temporary Utilities
2.1.2.2.1 Providing Water
2.1.2.2.1.1 Connecting
2.1.2.2.1.2 Plumbing
2.1.2.2.1.3 Welling
2.1.2.2.1.4 Storing
2.1.2.2.2 Providing Power
2.1.2.2.2.1 Connecting
2.1.2.2.2.2 Wiring
2.1.2.2.2.3 Generating

2.1.3 Surveying for Construction

2.1.3.1 Referencing to Existing Features
2.1.3.1.1. Measuring
2.1.3.1.1.1 Reading
2.1.3.1.1.2 Recording
2.1.3.1.2 Marking

2.1.3.2 Laying Out the Structure
2.1.3.2.1 Establishing Control Points
2.1.3.2.1.1 Measuring
2.1.3.2.1.2 Marking
2.1.3.2.2 Establishing Offset Lines
2.1.3.2.2.1 Measuring
2.1.3.2.2.2 Marking
2.1.3.2.2.3 Leveling
2.1.3.2.2.4 Protecting

2.1.4 Earthworking

2.1.4.1 Mobilizing Equipment
- **2.1.4.1.1 Transporting**
  - *2.1.4.1.1.1 Driving*
  - *2.1.4.1.1.2 Hauling and Towing*
- **2.1.4.1.2 Setting-up**
  - *2.1.4.1.2.1 Unloading*
  - *2.1.4.1.2.2 Positioning*
  - *2.1.4.1.2.3 Assembling*
  - *2.1.4.1.2.4 Servicing*

2.1.4.2 Earthmoving
- **2.1.4.2.1 Loosening**
  - *2.1.4.2.1.1 Blasting*
  - *2.1.4.2.1.2 Breaking and Spalling*
  - *2.1.4.2.1.3 Scarifying and Ripping*
- **2.1.4.2.2 Extracting**
  - *2.1.4.2.2.1 Digging*
  - *2.1.4.2.2.2 Scraping*
  - *2.1.4.2.2.3 De-Watering*
- **2.1.4.2.3 Transferring**
  - *2.1.4.2.3.1 Loading and Hauling*
  - *2.1.4.2.3.2 Pushing*
  - *2.1.4.2.3.3 Pumping*
  - *2.1.4.2.3.4 Conveying*
- **2.1.4.2.4 Disposing**
  - *2.1.4.2.4.1 Stockpiling-Stacking*
  - *2.1.4.2.4.2 Depositing*
  - *2.1.4.2.4.3 Spreading*

2.1.4.3 Protecting Existing Utilities and Structures
- **2.1.4.3.1 Rerouting**
- **2.1.4.3.2 Bracing and Shoring**
- **2.1.4.3.3 Underpinning**
  - *2.1.4.3.3.1 Digging*
  - *2.1.4.3.3.2 Supporting*

2.1.4.4 Shaping and Stabilizing Earthworks
- **2.1.4.4.1 Cleaning or Washing**
- **2.1.4.4.2 Grading**
  - *2.1.4.4.2.1 Compacting*
  - *2.1.4.4.2.2 Grouting*
  - *2.1.4.4.2.3 Scaling*
  - *2.1.4.4.2.4 Filling*
- **2.1.4.4.3 Slipping**
- **2.1.4.4.4 Sheathing**
- **2.1.4.4.5 Bracing and Shoring**
- **2.1.4.4.6 Treating**
- **2.1.4.4.7 Piling**
- **2.1.4.4.8 Cofferdamming**

2.2 Building the Structure

2.2.1 Setting Foundations

2.2.1.1 Making and Placing Forms
- **2.2.1.1.1 Building Forms**
  - *2.2.1.1.1.1 Laying Out*
  - *2.2.1.1.1.2 Cutting*
  - *2.2.1.1.1.3 Preassembling Components*
- **2.2.1.1.2 Assembling in Place**
  - *2.2.1.1.2.1 Transferring*
  - *2.2.1.1.2.2 Positioning*
  - *2.2.1.1.2.3 Fastening*
  - *2.2.1.1.2.4 Stabilizing and Adjusting*
- **2.2.1.1.3 Treating Forms**
  - *2.2.1.1.3.1 Cleaning*
  - *2.2.1.1.3.2 Coating*
  - *2.2.1.1.3.3 Soaking*

2.2.1.2 Setting Reinforcement
- **2.2.1.2.1 Cleaning and Shaping**
- **2.2.1.2.2 Transferring and Placing**
- **2.2.1.2.3 Supporting**
  - *2.2.1.2.3.1 Seating*
  - *2.2.1.2.3.2 Tying*

2.2.1.3 Preparing Foundation Materials
- **2.2.1.3.1 Treating**
  - *2.2.1.3.1.1 Washing*
  - *2.2.1.3.1.2 Chilling*
- **2.2.1.3.2 Proportioning and Batching**
  - *2.2.1.3.2.1 Screening*
  - *2.2.1.3.2.2 Measuring*
- **2.2.1.3.3 Mixing**

2.2.1.4 Handling Materials
- **2.2.1.4.1 Transferring**
  - *2.2.1.4.1.1 Hauling*
  - *2.2.1.4.1.2 Conveying*
  - *2.2.1.4.1.3 Pumping*
- **2.2.1.4.2 Placing**
  - *2.2.1.4.2.1 Dumping*
  - *2.2.1.4.2.2 Chuting*
- **2.2.1.4.3 Consolidating**
  - *2.2.1.4.3.1 Vibrating*
  - *2.2.1.4.3.2 Tamping and Spading*
- **2.2.1.4.4 Building in Inserts, Anchors, Ties, Hangers**
- **2.2.1.4.5 Finishing**
  - *2.2.1.4.5.1 Striking Off*
  - *2.2.1.4.5.2 Edging*
  - *2.2.1.4.5.3 Floating*

2.2.1.5 Bonding
- **2.2.1.5.1 Preparing Surfaces**
  - *2.2.1.5.1.1 Scraping*
  - *2.2.1.5.1.2 Washing*
  - *2.2.1.5.1.3 Grouting*
- **2.2.1.5.2 Jointing**
  - *2.2.1.5.2.1 Placing*
  - *2.2.1.5.2.2 Tamping*

2.2.1.6 Curing

2.2.1.6.1 Controlling Moisture
2.2.1.6.1.1 Ponding and Flooding
2.2.1.6.1.2 Mist Spraying
2.2.1.6.1.3 Covering
2.2.1.6.1.4 Chemical Treating
2.2.1.6.2 Controlling Temperature
2.2.1.6.2.1 Chilling
2.2.1.6.2.2 Covering

2.2.1.7 Removing Forms
2.2.1.7.1 Stripping Forms
2.2.1.7.1.1 Unfastening
2.2.1.7.1.2 Tapping
2.2.1.7.1.3 Pulling
2.2.1.7.1.4 Lifting and Stacking
2.2.1.7.2 Cleaning Forms
2.2.1.7.2.1 Chipping and Scraping
2.2.1.7.2.2 Washing
2.2.1.7.2.3 Stockpiling

2.2.1.8 Finishing Foundations
2.2.1.8.1 Cleaning
2.2.1.8.1.1 Patching
2.2.1.8.1.2 Chipping and Chiseling
2.2.1.8.1.3 Treating
2.2.1.8.2 Backfilling
2.2.1.8.2.1 Bulldozing
2.2.1.8.2.2 Compacting

2.2.2 Building the Major Structural Elements

2.2.2.1 Preparing Materials
2.2.2.1.1 Laying Out
2.2.2.1.2 Cutting
2.2.2.1.3 Forming
2.2.2.1.4 Proportioning and Mixing
2.2.2.1.5 Treating

2.2.2.2 Fabricating Components and Temporary Forms
2.2.2.2.1 Preparing Materials
2.2.2.2.2 Sub-Assembling

2.2.2.3 Setting Reinforcement
2.2.2.4 Handling Materials and Components
2.2.2.4.1 Transferring
2.2.2.4.1.1 Hoisting
2.2.2.4.1.2 Carrying
2.2.2.4.2 Positioning
2.2.2.4.2.1 Locating
2.2.2.4.2.2 Bracing and Holding
2.2.2.4.2.3 Aligning
2.2.2.4.2.4 Placing
2.2.2.4.3 Assembling
2.2.2.4.3.1 Fastening
2.2.2.4.3.1.1 Pinning
2.2.2.4.3.1.2 Welding
2.2.2.4.3.2 Bonding
2.2.2.4.3.2.1 Joining
2.2.2.4.3.2.2 Adhering

2.2.2.5 Treating
2.2.2.5.1 Curing
2.2.2.5.2 Tensioning
2.2.2.5.3 Pressurizing
2.2.2.5.4 Coating
2.2.2.5.5 Fireproofing

2.2.2.6 Removing Temporary Forms
2.2.2.6.1 Stripping
2.2.2.6.2 Cleaning
2.2.2.6.3 Stockpiling

2.2.2.7 Finishing
2.2.2.7.1 Abrading
2.2.2.7.2 Patching
2.2.2.7.3 Coating

2.3 Installing Utility Systems (e.g., Electrical, Plumbing, Communication, HVAC, Transportation)

2.3.1 Installing Permanent Utilities and Mechanical Plant

2.3.1.1 Preparing Materials and Components
2.3.1.1.1 Laying Out
2.3.1.1.2 Cutting
2.3.1.1.3 Forming
2.3.1.1.4 Treating
2.3.1.1.5 Fabricating Components

2.3.1.2 Handling Materials
2.3.1.2.1 Transferring
2.3.1.2.2 Positioning

2.3.1.3 Fastening in Place
2.3.1.3.1 Pinning
2.3.1.3.2 Welding
2.3.1.3.3 Hooking
2.3.1.3.4 Clamping
2.3.1.3.5 Embedding and Seating

2.3.1.4 Connecting and Jointing
2.3.1.4.1 Bonding
2.3.1.4.2 Pinning
2.3.1.4.3 Welding
2.3.1.4.4 Soldering
2.3.1.4.5 Splicing
2.3.1.4.6 Clamping
2.3.1.4.7 Socketing
2.3.1.4.8 Sealing
2.3.1.4.9 Treating

2.3.2 Providing Temporary Equipment

2.3.2.1 Handling Equipment
2.3.2.1.1 Transferring
2.3.2.1.2 Positioning
2.3.2.1.3 Assembling

2.3.2.2 Securing in Place
2.3.2.2.1 Pinning
2.3.2.2.2 Welding
2.3.2.2.3 Clamping
2.3.2.2.4 Tying
2.3.2.2.5 Bracing
2.3.2.2.6 Hooking

2.3.2.3 Removing Temporary Equipment
2.3.2.3.1 Disassembling
2.3.2.3.2 Handling Equipment
2.3.2.3.2.1 Loading
2.3.2.3.2.2 Hauling
2.3.2.3.2.3 Stockpiling

2.4 Enclosing the Structure (Rough Finishing)

2.4.1 Preparing Materials

2.4.1.1 Laying Out
2.4.1.2 Cutting
2.4.1.3 Forming
2.4.1.4 Mixing
2.4.1.5 Making Temporary Formwork
2.4.1.6 Fabricating Components
2.4.1.7 Treating

2.4.2 Handling Materials and Components

2.4.2.1 Transferring Materials and Components
2.4.2.2 Positioning Materials and Components

2.4.3 Assembling in Place

2.4.3.1 Pinning
2.4.3.2 Welding
2.4.3.3 Bonding
2.4.3.4 Coupling

2.5 Finishing the Structure (Fine Finishing)

2.5.1 Preparing Subsurfaces

2.5.1.1 Abrading
2.5.1.2 Grounding

2.5.2 Preparing Materials

2.5.2.1 Laying Out
2.5.2.2 Cutting
2.5.2.3 Forming
2.5.2.4 Mixing
2.5.2.5 Making Temporary Formwork
2.5.2.6 Assembling Prefabricated Components
2.5.2.7 Treating

2.5.3 Handling Materials

2.5.3.1 Transferring Materials
2.5.3.2 Positioning

2.5.4 Trimming

2.5.4.1 Fastening and Connecting
2.5.4.1.1 Pinning
2.5.4.1.2 Welding
2.5.4.1.3 Bonding
2.5.4.1.4 Coupling

2.5.4.2 Coating and Applying
2.5.4.2.1 Brushing
2.5.4.2.2 Spraying
2.5.4.2.3 Rolling
2.5.4.2.4 Troweling
2.5.4.2.5 Sealing

2.5.5 Removing Equipment and Debris

2.5.5.1 Demobilizing Equipment
2.5.5.1.1 Disassembling
2.5.5.1.2 Transferring

2.5.5.2 Cleaning Up
2.5.5.2.1 Scraping
2.5.5.2.2 Picking Up
2.5.5.2.3 Sweeping
2.5.5.2.4 Washing
2.5.5.2.5 Polishing

2.6 Completing the Site

2.6.1 Removing Temporary Plant and Facilities

2.6.1.1 Removing Temporary Water and Power Facilities
2.6.1.1.1 Disassembling, Disconnecting
2.6.1.1.2 Handling Components

2.6.1.2 Removing Contractor's Equipment
2.6.1.2.1 Disassembling
2.6.1.2.2 Handling Equipment
2.6.1.2.2.1 Loading
2.6.1.2.2.2 Hauling

2.6.2 Landscaping

2.6.2.1 Building Accesses

2.6.2.1.1 Surveying for Accesses
2.6.2.1.2 Earthmoving
2.6.2.1.3 Setting the Base
2.6.2.1.4 Installing Circulatory Systems
2.6.2.1.5 Finishing the Access
2.6.2.1.5.1 Surfacing
2.6.2.1.5.2 Trimming

2.6.3 Building Features

2.6.3.1 Surveying for Construction
2.6.3.2 Earthmoving
2.6.3.3 Building the Feature
2.6.3.4 Installing Circulatory Systems
2.6.3.5 Finishing the Feature

2.6.4 Shaping the Finishing Earth

2.6.4.1 Laying Out
2.6.4.2 Earthmoving
2.6.4.2.1 Banking
2.6.4.2.2 Filling

2.6.4.3 Preparing the Surface
2.6.4.3.1 Grading
2.6.4.3.2 Turning
2.6.4.3.3 Spreading
2.6.4.3.4 Treating

2.6.4.4 Planting and Surfacing
2.6.4.4.1 Seeding
2.6.4.4.2 Sodding
2.6.4.4.3 Digging and Placing
2.6.4.4.4 Spreading
2.6.4.4.5 Treating
2.6.4.4.6 Protecting

2.6.5 Removing Landscaping Equipment and Debris

2.6.5.1 Demobilizing Equipment
2.6.5.1.1 Loading and Hauling
2.6.5.1.2 Towing
2.6.5.1.3 Driving

2.6.5.2 Cleaning Up
2.6.5.2.1 Picking Up
2.6.5.2.2 Raking
2.6.5.2.3 Sweeping
2.6.5.2.4 Burying
2.6.5.2.5 Burning
2.6.5.2.6 Dumping

2.7 Servicing the Project

2.7.1 Diagnosing/Troubleshooting
2.7.2 Repairing
2.7.3 Altering
2.7.4 Installing
2.7.5 Maintaining

3. Construction Managerial Processes

3.1 Planning

3.1.1 Formulating

3.1.1.1 Determining Goals
3.1.1.2 Establishing Specific Objectives
3.1.1.3 Setting Policies
3.1.1.4 Forecasting
3.1.1.5 Programming

3.1.2 Researching

3.1.2.1 Retrieving
3.1.2.2 Describing
3.1.2.3 Experimenting

3.1.3 Designing

3.1.3.1 Determining Function
3.1.3.2 Preparing Performance Specifications
3.1.3.3 Postulating a Solution-in-Principle
3.1.3.4 Making Simple Models
3.1.3.5 Postulating Alternate Solutions
3.1.3.6 Making Working or Scale Models
3.1.3.7 Selecting Solution
3.3 3.8 Communicating Design Solution
3.3.3.9 Making Prototype

3.1.4 Engineering

3.1.4.1 Detailing Design Communication
3.1.4.2 Detailing Specifications and Standards
3.1.4.3 Work Design (Methods, Standards, Processes)
3.1.4.4 Estimating
3.1.4.5 Scheduling

3.2 Organizing

3.2.1 Structuring

3.2.1.1 Analyzing Work Tasks
3.2.1.2 Determining Worker Functions
3.2.1.3 Establishing Roles
3.2.1.4 Setting Work Conditions

3.2.2 Supplying

3.2.2.1 Requisitioning
3.2.2.2 Procuring
(Subcontracting)
3.2.2.2.1 Advertising for Bid(s)
3.2.2.2.1.1 Inviting Bid(s)
3.2.2.2.1.2 Selecting Bidder(s)
3.2.2.2.1.3 Instructing Bidder(s)
3.2.2.2.2 Preparing Bid(s)
3.2.2.2.2.1 Inspecting Site
3.2.2.2.2.2 Quantifying Labor and Materials
3.2.2.2.2.3 Estimating
3.2.2.2.3 Accepting Bids
3.2.2.2.3.1 Opening Bids
3.2.2.2.3.2 Selecting a Bid

3.2.2.3 Employing
3.2.2.3.1 Specifying Work Roles
3.2.2.3.2 Notifying Prospective Employees
3.2.2.3.3 Selecting Personnel

3.2.2.4 Purchasing
3.2.2.4.1 Writing Detailed Specifications
3.2.2.4.2 Ordering
3.2.2.4.3 Checking
3.2.2.4.4 Claiming

3.2.2.5 Leasing
3.2.2.5.1 Writing Detailed Specifications
3.2.2.5.2 Ordering
3.2.2.5.3 Checking
3.2.2.5.4 Claiming
3.2.2.5.5 Returning

3.2.2.6 Obtaining Licenses, Permits, and Authorizations
3.2.2.6.1 Applying
3.2.2.6.2 Securing

3.2.3 Scheduling

3.2.3.1 Grouping
3.2.3.2 Allocating Time

3.2.4 Routing

3.2.4.1 Establishing Departure and Arrival Time
3.2.4.2 Establishing Path to be Followed

3.2.5 Storing

3.3 Directing

3.3.1 Coordinating
3.3.2 Assigning
3.3.3 Supervising
3.3.4 Inspecting
3.3.5 Authorizing

3.4 Controlling

3.4.1 Monitoring

3.4.1.1 Inspecting
3.4.1.2 Inventorying
3.4.1.3 Timekeeping

3.4.2 Reporting

3.4.2.1 Compiling
3.4.2.2 Appraising
3.4.2.3 Notifying

3.4.3 Correcting

3.4.3.1 Adjusting
3.4.3.2 Expediting
3.4.3.3 Restraining
3.4.3.4 Replanning
3.4.3.5 Redirecting
3.4.3.6 Retraining

Manufacturing

1. Manufacturing Inputs

1.1 Material

1.1.1 Direct
1.1.2 Indirect

1.2 Human

1.2.1 Managerial
1.2.2 Scientific/Technical
1.2.3 Office/Clerical
1.2.4 Worker/Operator

1.3 Capital

1.3.1 Plant
1.3.2 Equipment

1.4 Finance

1.4.1 Debt
1.4.2 Equity

1.5 Knowledge

1.5.1 Technological
1.5.2 Scientific
1.5.3 Humanities
1.5.4 Formal

1.6 Energy

2. Transformation Processes

2.1 Extracting

2.1.1 Drilling

2.1.1.1 Methods
2.1.1.1.1 Cable tool
2.1.1.1.2 Rotary

2.1.1.2 Extracting Materials

2.1.1.2.1 Energy Drive
2.1.1.2.2 Pumping

2.1.2 Harvesting (Cutting)

2.1.2.1 Selective
2.1.2.2 Clear Cutting

2.1.3 Mining

2.1.3.1 Surface Mining
2.1.3.1.1 Placer
2.1.3.1.1.1 Panning
2.1.3.1.2 Dredging
2.1.3.1.2.1 Floating
2.1.3.1.2.2 Drag Line
2.1.3.1.3 Open Pit
2.1.3.1.4 Strip
2.1.3.1.5 Quarry

2.1.3.2 Underground
2.1.3.2.1 Level and Shaft
2.1.3.2.2 Room and Pillar

2.1.3.3 Underwater
2.1.3.3.1 Precipitating
2.1.3.3.2 Leaching
2.1.3.3.3 Frasch
2.1.3.3.4 Drag Line

2.1.4 Other

2.1.4.1 Evaporation
2.1.4.2 Electrolysis

2.2 Primary Processing

2.2.1 Thermal Processing

2.2.1.1 Smelting
2.2.1.2 Distilling
2.2.1.3 Evaporating

2.2.2 Chemical Processing

2.2.2.1 Oxidizing
2.2.2.2 Reducing

2.2.3 Mechanical Processing

2.2.3.1 Cutting
2.2.3.2 Slicing and Shearing
2.2.3.3 Crushing and Milling
2.2.3.4 Screening

2.2.3.5 Floating and Sedimenting
2.2.3.6 Filtering

2.2.4 Electrical Processing

2.2.4.1 Magnetic Separating
2.2.4.2 Electrostatic Separating

2.3 Secondary Processing

2.3.1 Casting and Molding

2.3.1.1 Preparing the Mold
2.3.1.1.1 Expendable
2.3.1.1.2 Permanent

2.3.1.2 Preparing the Material
2.3.1.2.1 Melting
2.3.1.2.2 Dissolving/Suspending
2.3.1.2.3 Compounding Liquids

2.3.1.3 Introducing Materials into Molds
2.3.1.3.1 Pouring
2.3.1.3.2 Pressurizing

2.3.1.4 Solidifying the Material
2.3.1.4.1 Cooling
2.3.1.4.2 Drying
2.3.1.4.3 Chemical Condition (reaction)

2.3.1.5 Extracting the Casting/Molded Part
2.3.1.5.1 Destroying the Mold
2.3.1.5.2 Open the Mold/Ejecting

2.3.2 Forming

2.3.2.1 Selecting the Shaping Device
2.3.2.1.1 Die/Form/Mold
2.3.2.1.1.1 Open
2.3.2.1.1.2 Mated (closed)
2.3.2.1.1.3 One-Piece Shaped
2.3.2.1.2 Roll
2.3.2.1.2.1 Straight/Smooth
2.3.2.1.2.2 Shaped

2.3.2.2 Determining Material Temperature
2.3.2.2.1 Hot Forming
2.3.2.2.2 Cold Forming

2.3.2.3 Producing Forming Forces (sources of pressure)
2.3.2.3.1 Machine Tool
2.3.2.3.1.1 Press
2.3.2.3.1.2 Hammer
2.3.2.3.1.3 Rolling Mill
2.3.2.3.14 Draw Bench
2.3.2.3.2 Other
2.3.2.3.2.1 Air Pressure
2.3.2.3.2.2 Vacuum
2.3.2.3.2.3 High Energy Rate (HER)

2.3.3 Separating

2.3.3.1 Selecting the Cutting Element
2.3.3.1.1 Single-Point Tool
2.3.3.1.2 Multiple-Point Tool
2.3.3.1.2.1 Symmetrical
2.3.3.1.2.2 Random
2.3.3.1.3 Other
2.3.3.1.3.1 Sound
2.3.3.1.3.2 Flame
2.3.3.1.3.3 Electrical Spark
2.3.3.1.3.4 Chemical
2.3.3.1.3.5 Other

2.3.3.2 Generating Feed and Cutting Motion
2.3.3.2.1 Reciprocating
2.3.3.2.1.1 Work
2.3.3.2.1.2 Cutting Element
2.3.3.2.2 Rotating
2.3.3.2.2.1 Work
2.3.3.2.2.2 Cutting Element
2.3.3.2.3 Linear
2.3.3.2.3.1 Work
2.3.3.2.3.2 Cutting Element

2.3.3.3 Clamping Cutting Elements and Work
2.3.3.3.1 Cutting Element Clamping
2.3.3.3.2 Work Clamping

2.3.4 Conditioning

2.3.4.1 Chemical Conditioning
2.3.4.1.1 Fermentation
2.3.4.1.2 Crystallization
2.3.4.1.3 Polymerization

2.3.4.2 Thermal Conditioning
2.3.4.2.1 Heat Treating/Firing
2.3.4.2.2 Melting
2.3.4.2.3 Freezing
2.3.4.2.4 Drying

2.3.4.3 Mechanical Conditioning (Work Hardening)

2.3.5 Assembling

2.3.5.1 Bonding
2.3.5.1.1 Selecting Bonding Agents
2.3.5.1.1.1 Same Material
2.3.5.1.1.2 Similar Material
2.3.5.1.1.3 Different Material
2.3.5.1.2 Selecting Bonding Method
2.3.5.1.2.1 Fusion Bonding
2.3.5.1.2.2 Flow Bonding
2.3.5.1.2.3 Pressure Bonding
2.3.5.1.2.4 Cold Bonding
2.3.5.1.2.5 Adhesive Bonding

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2.3.5.1.3 Selecting Joints
2.3.5.1.3.1 Tee
2.3.5.1.3.2 Corner
2.3.5.1.3.3 Butt
2.3.5.1.3.4 Skarf
2.3.5.1.3.5 Lap

2.3.5.2 Mechanical Fastening
2.3.5.2.1 Selecting the Fastening Agent
2.3.5.2.1.1 Mechanical Fastening
2.3.5.2.1.2 Mechanical Force
2.3.5.2.2 Installing Fasteners

2.3.6 Finishing

2.3.6.1 Selecting the Finishing Material
2.3.6.1.1 Converted Surfaces
2.3.6.1.2 Coatings
2.3.6.1.2.1 Organic
2.3.6.1.2.2 Inorganic

2.3.6.2 Preparing the Material to be Finished
2.3.6.2.1 Deburring
2.3.6.2.2 Mechanical Cleaning
2.3.6.2.3 Chemical Cleaning

2.3.6.3 Applying Finishes
2.3.6.3.1 Chemical Techniques
2.3.6.3.2 Mechanical Techniques
2.3.6.3.2.1 Brushing
2.3.6.3.2.2 Rolling
2.3.6.3.2.3 Spraying
2.3.6.3.2.4 Dipping
2.3.6.3.2.5 Curtain Coating (Flowing)
2.3.6.3.3 Electrical Techniques

3. Managerial Processes

3.1 Managerial Functions

3.1.1 Planning

3.1.1.1 Determining Objectives
3.1.1.2 Forecasting
3.1.1.3 Establishing Tasks for Each Objective
3.1.1.4 Developing Procedures for Meeting Tasks
3.1.1.5 Developing Policies

3.1.2 Organizing

3.1.2.1 Developing Chains of Command
3.1.2.2 Specifying Position Tasks and Requirements
3.1.2.3 Staffing Positions

3.1.3 Actuating (Directing)

3.1.3.1 Issuing Work Orders and Directions
3.1.3.2 Motivating Employees
3.1.3.3 Communicating Goals, Work Requirements, etc.
3.1.3.4 Rewarding Appropriate Performance

3.1.4 Controlling

3.1.4.1 Comparing Results with Plans
3.1.4.2 Suggesting Corrective Action
3.1.4.3 Reporting Performance Results

3.2 Types of Managed Production Systems

3.2.1 Custom
3.2.2 Intermittent

3.2.2.1 Job-lot
3.2.2.2 Batch

3.2.3 Continuous

3.3 Managed System Activities

3.3.1 Establishing the Organization

3.3.1.1 Generating Capital
3.3.1.2 Structuring the Organization
3.3.1.3 Employing Managerial Personnel

3.3.2 Designing the Product

3.3.2.1 Researching
3.3.2.2 Developing
3.3.2.3 Product Engineering

3.3.3 Preparing to Produce the Product

3.3.3.1 Manufacturing Engineering
3.3.3.2 Production Planning and Control
3.3.3.3 Employing Production Personnel
3.3.3.4 Training
3.3.3.5 Procuring/Purchasing

3.3.4 Producing the Product

3.3.4.1 Processing Materials
3.3.4.2 Controlling Quality
3.3.4.3 Establishing Safety Programs
3.3.4.4 Providing Employee Services
3.3.4.5 Administering Wages and Salaries

3.3.5 Delivering the Product

3.3.5.1 Advertising
3.3.5.2 Selling
3.3.5.3 Distributing

3.3.6 Servicing the Product

3.3.6.1 Installing
3.3.6.2 Maintaining
3.3.6.3 Diagnosing
3.3.6.4 Repairing
3.3.6.5 Testing
3.3.6.6 Modifying

3.3.7 Controlling the System

3.3.7.1 Monitoring
3.3.7.2 Assessing
3.3.7.3 Reporting
3.3.7.4 Altering

4. Manufacturing Outputs

4.1 Primary Outputs

4.1.1 Raw Materials

4.1.1.1 State
4.1.1.1.1 Liquid
4.1.1.1.2 Gas
4.1.1.1.3 Solid

4.1.1.2 Properties
4.1.1.2.1 Mechanical
4.1.1.2.2 Physical
4.1.1.2.3 Chemical
4.1.1.2.4 Thermal

4.1.2 Industrial Goods

4.1.2.1 Types
4.1.2.1.1. Polymeric
4.1.2.1.2 Metallic
4.1.2.1.3 Ceramic
4.1.2.1.4 Composite

4.1.2.2 Properties
4.1.2.2.1 Mechanical
4.1.2.2.2 Physical
4.1.2.2.3 Chemical
4.1.2.2.4 Electrical/Mechanical
4.1.2.2.5 Optical
4.1.2.2.6 Acoustical

4.1.3 Finished Goods

4.1.3.1 Classes
4.1.3.1.1 Consumer
4.1.3.1.2 Industrial
4.1.3.1.3 Military

4.1.3.2 User Selection Criteria
4.1.3.2.1 Appearance
4.1.3.2.2 Function
4.1.3.2.3 Economic Value
4.1.3.2.4 Status Value
4.1.3.2.5 Environmental Impact

4.2 Other Outputs

4.2.1 Scrap

4.2.1.1 Recyclable
4.2.1.2 Waste

4.2.2 Pollution

4.2.2.1 Air
4.2.2.2 Water
4.2.2.3 Land/Soil
4.2.2.4 Ecocycle
4.2.2.5 Noise

Transportation

1. Technological Base

1.1 Elements of Transportation

1.1.1 Human Mobility
1.1.2 Activity (Movement of Goods and People)
1.1.3 Physical (Natural and Man-Made)

1.2 Conquest of Time and Space

1.3 Foundational Developments

1.3.1 Inventions
1.3.2 Innovation

1.4 Transportation Systems (People)

1.4.1 Personalized (Individual)

1.4.1.1 Random Route
1.4.1.2 Fixed Route

1.4.2 Mass Transit

1.4.2.1 Random Route
1.4.2.2 Fixed Route

1.5 Transportation Systems (Materials and Goods)

1.5.1 Natural Forms of Movement
1.5.2 Technologies of Transport

1.5.2.1 Containers
1.5.2.2 Vehicles
1.5.2.3 Terminals
1.5.2.4 Pathways

1.6 Environment Mediums

1.6.1 Terrestrial
1.6.2 Marine
1.6.3 Atmospheric
1.6.4 Space
1.6.5 Interrelated

2. Acts of Transporting

2.1 Receiving (People/Materials and Goods)

2.1.1 People (Personalized and Mass Transit)

2.1.1.1 Terminal (Multi-Modal Interface Facility)
2.1.1.2 Station (Bi-Modal Interface Facility)
2.1.1.3 Random and Fixed Points

2.1.2 Materials/Goods (Bulk, Gross, Packaged)

2.1.2.1 Terminal (Multi-Modal Interface Facility)
2.1.2.2 Warehouse (Bi-Modal Receiving Facility)
2.1.2.3 Random/Fixed Points

2.2 Holding/Storing

2.2.1 People (Personalized and Mass Transit)

2.2.1.1 Terminal
2.2.1.2 Station (Intermodal)
2.2.1.3 Random/Fixed Point (Intra-Modal)

2.2.2 Materials /Goods (Bulk, Gross, Packaged)

2.2.2.1 Terminal
2.2.2.2. Warehouse
2.2.2.3 Random/Fixed Points

2.3 Loading (People/Materials and Goods)

2.3.1 Manual
2.3.2 Mechanical (Manually Operated)

2.3.3 Mechanized

2.3.3.1 Semi-Automated
2.3.3.2 Automated

2.3.4 Hybrid

2.4 Moving of Goods/Materials/People

2.4.1 Terrestrial Modes and Systems (Personalized–Individual–Mass)

2.4.1.1 Human Locomotion
2.4.1.2 Carts and Wagons
2.4.1.3 Railways
2.4.1.3.1 Conventional Surface Rail
2.4.1.3.2 Subsurface Rail
2.4.1.3.3 Elevated Rail
2.4.1.3.4 Trolley Rail

2.4.1.4 Personal Rapid Transit
2.4.1.5 Bicycle
2.4.1.6 Motorcycle
2.4.1.7 Automobile
2.4.1.8 Bus
2.4.1.9 Snowmobile
2.4.1.10 Special Purpose
2.4.1.10.1 Elevators
2.4.1.10.2 Escalators
2.4.1.10.3 Moving Sidewalks

2.4.1.11 Tube Transportation
2.4.1.12 Multi-Modal

2.4.2 Terrestrial Modes and Systems (Cargo—Bulk/Unit)

2.4.2.1 Railway
2.4.2.2 Truck
2.4.2.3 Continuous Capacity Systems (Stationary)
2.4.2.3.1 Conveyors (Mechanical/Pneumatic)
2.4.2.3.2 Pipelines

2.4.3 Marine Modes and Systems

2.4.3.1 Inland Waterways
2.4.3.1.1 Canals
2.4.3.1.2 Rivers
2.4.3.1.3 Lakes
2.4.3.1.4 Coastal

2.4.3.2 Transoceanic Maritime
2.4.3.2.1 Canals
2.4.3.2.2 Oceans

2.4.3.3 Marine Modes (Personal/Mass and Bulk/Units)
2.4.3.3.1 Canoe
2.4.3.3.2 Power Boat
2.4.3.3.3 Sail Boat
2.4.3.3.4 Raft
2.4.3.3.5 Barge
2.4.3.3.6 Towboat
2.4.3.3.7 Tugboat
2.4.3.3.8 Hydrofoil Vessel
2.4.3.3.9 Hovercraft Vessel
2.4.3.3.10 Container Ship
2.4.3.3.11 Tanker
2.4.3.3.12 Freighter
2.4.3.3.13 Aircraft Carrier
2.4.3.3.14 Ocean Liner
2.4.3.3.15 Merchant Ship
2.4.3.3.16 Battleship
2.4.3.3.17 Cruiser
2.4.3.3.18 Submarine

2.4.4 Atmospheric Modes and Systems (People and Goods)

2.4.4.1 Lighter-Than-Air
2.4.4.1.1 Rigid Airship
2.4.4.1.2 Semi-Rigid Airship
2.4.4.1.3 Balloon

2.4.4.2 Heavier-Than-Air
2.4.4.2.1 Conventional Aircraft (Passenger)
2.4.4.2.2 Helicopter
2.4.4.2.3 Military Aircraft
2.4.4.2.4 Special Purpose Aircraft
2.4.4.2.5 Cargo Aircraft

2.4.5 Space Modes and Systems

2.4.5.1 Manned Space Vehicles
2.4.5.1.1 Spacecraft
2.4.5.1.2 Space Shuttle

2.4.5.2 Unmanned Space Vehicles
2.4.5.2.1 Missiles
2.4.5.2.2 Launch Vehicles
2.4.5.2.3 Satellites
2.4.5.2.4 Space Probes

2.5 Unloading

2.5.1 Automated/Mechanized
2.5.2 Manual/Mechanized
2.5.3 Manual
2.5.4 Hybrid

2.6 Delivering

2.6.1 Means of Delivering to Final Destination

2.6.1.1 Self-locomotion
2.6.1.2 Fixed Route to Random
2.6.1.3 Check-in/Receiving

3. Technical Systems

3.1 Energy Sources and Conversion

3.1.1 Energy Sources

3.1.1.1 Electrical
3.1.1.2 Chemical
3.1.1.3 Kinetic
3.1.1.4 Gravity
3.1.1.5 Mechanical
3.1.1.6 Magnetic
3.1.1.7 Solar
3.1.1.8 Nuclear

3.1.2 Conversion Systems

3.1.2.1 Internal Combustion
3.1.2.2 External Combustion
3.1.2.3 Hybrid Systems
3.1.2.3.1 Mechanical/Mechanical
3.1.2.3.2 Chemical/Chemical
3.1.2.3.3 Electrical/Mechanical
3.1.2.3.4 Chemical/Electrical

3.2 Propulsion Systems

3.2.1 Mechanical Drive Systems
3.2.2 Hydraulic Drive Systems
3.2.3 Electric Drive Systems

3.2.3.1 Generator/Motor (Rotary)
3.2.3.2 Linear Induction

3.2.4 Vacuum
3.2.5 Gravity
3.2.6 Reaction

3.2.6.1 Water Jet
3.2.6.2 Air Reaction
3.2.6.3 Rocket (Liquid/Solid)

3.2.7 Storage Devices

3.3 Suspension Systems

3.3.1 Mechanical Suspension

3.3.1.1 Wheel on Surface
3.3.1.2 Wheel on Rail
3.3.1.3 Wheel on Guideway
3.3.1.4 Monorail Systems
3.3.1.5 Sliding Devices

3.3.2 Fluid Suspension

3.3.2.1 Aerostatic Lift
3.3.2.1.1 Air Cushion
3.3.2.1.2 Air Film

3.3.2.2 Hydrostatic
3.3.2.3 Hydrodynamic
3.3.2.3.1 Foil
3.3.2.3.2 Lift

3.3.2.4 Aerodynamic

3.3.3 Magnetic Suspension

3.3.3.1 Permanent Magnet
3.3.3.2 Electromagnet

3.4 Control Systems (Degrees of Freedom)

3.4.1 Velocity Control

3.4.1.1 Acceleration
3.4.1.2 Deceleration
3.4.1.3 Braking

3.4.2 Directional Control
3.4.3 Attitude Control
3.4.4 Altitude Control
3.4.5 Vehicular and System Control

3.4.5.1 Manually
3.4.5.2 Remote
3.4.5.3 Regulatory

3.5 Guidance Systems

3.5.1 Guideway Systems

3.5.1.1 Highway
3.5.1.2 Rail Flange
3.5.1.3 Tube
3.5.1.4 Canal
3.5.1.5 Cable
3.5.1.6 Monorail

3.5.2 On-Board and External Guidance Devices/Systems

3.5.2.1 Sensing Systems
3.5.2.2 Encoding Systems
3.5.2.3 Transmitting Systems
3.5.2.4 Signaling Systems
3.5.2.5 Receiving Systems
3.5.2.6 Decoding Systems
3.5.2.7 Storing Systems
3.5.2.8 Retrieval Systems

3.5.3 Interrelationship of Guidance and Control Systems

3.6 Structural Systems

3.6.1 Vehicular—Design Considerations

3.6.1.1 Human Factors
3.6.1.2 Safety
3.6.1.3 Environmental
3.6.1.4 Performance
3.6.1.5 Economic Factors

3.6.2 Guideway Structures—Design Considerations

3.6.2.1 Railways
3.6.2.2 Monorails
3.6.2.3 Cableways
3.6.2.4 Beltways
3.6.2.5 Roadways
3.6.2.6 Bridges
3.6.2.7 Tunnels/Canals
3.6.2.8 Airport Runways

3.6.3 Support Systems—Structures

3.6.3.1 Terminals
3.6.3.2 Maintenance/Service
3.6.3.3 Roadside Rest Areas
3.6.3.4 Harbors
3.6.3.5 Load/Unloading Docks
3.6.3.6 Storage Facilities
3.6.3.7 Parking Lots and Ramps

3.7 Support Systems

3.7.1 Physical Facilities—Design Factors

3.7.1.1 Ticket Offices/Reservations
3.7.1.2 Harbors/Docks
3.7.1.3 Parking Facilities
3.7.1.4 Intermodal Interfaces
3.7.1.5 Baggage Handling
3.7.1.6 Other

3.7.2 Personnel

3.7.2.1 Selection
3.7.2.2 Training/Education
3.7.2.3 Career Opportunities
3.7.2.4 Economic Factors

3.7.3 Systems Regulatory Factors

3.7.3.1 Laws and Regulations
3.7.3.2 Licensing
3.7.3.3 Enforcement

3.7.4 Operational Systems

3.7.4.1 Traffic Management
3.7.4.2 Scheduling
3.7.4.3 Routes and Routing

4. Environmental Factors

4.1 Human/Social

4.1.1 Safety
4.1.2 Human Values and Desires
4.1.3 Enhancement of Social, Recreational, Cultural Programs and Facilities.
4.1.4 Comfort/Convenience
4.1.5 Demand Responsiveness
4.1.6 Service for Handicapped and Elderly
4.1.7 Privacy

4.2 Economic/Service

4.2.1 Transportation Costs
4.2.2 Access to Employment Opportunities
4.2.3 Efficiency

4.3 Physical and Functional

4.3.1 Effects on Land Use
4.3.2 Adaptable to Future Needs
4.3.3 Flexibility
4.3.4 Adaptable to Intermode Operation

4.4 Aesthetics

4.4.1 General Appearance in Relationship to Surrounding Environment
4.4.2 Conservation of Natural Resources

4.5 Interrelated

4.5.1 Level of Noise
4.5.2 Air and/or Water Pollution Characteristics
4.5.3 Neighborhood Growth and Development
4.5.4 Accessibility

C

*Standards for Technology Education Programs**

PHILOSOPHY. A current, comprehensive, written philosophical statement is available, and it influences thought and action for technology education.

Development

1. The statement is developed as a joint effort, with input from teachers; administrators and supervisory personnel; students; and parents and community representatives.

☐ Yes ☐ No
Recommended action:

2. The statement is consistent with local, state, and national philosophies of education and of technology education.

☐ Yes ☐ No
Recommended action:

3. The statement supports the existence of the program.

☐ Yes ☐ No
Recommended action:

Utilization

4. The statement is used as a basis for program planning, development, implementation, and evaluation.

☐ Yes ☐ No
Recommended action:

Revision

5. The statement is reviewed periodically and revised as necessary.

☐ Yes ☐ No
Recommended action:

*Adapted from Wisconsin Department of Public Instruction, *Standards for Technology Education* (Madison, WI: Department of Public Instruction, 1983).

INSTRUCTIONAL PROGRAM. The instructional program reflects the stated technology education philosophy through experiences designed to meet the needs of all students.

Goals

1. Program goals encompass the major purposes of technology education.

☐ Yes ☐ No
Recommended action:

2. Goals are consistent with local, state, and national standards and emerging developments in the field.

☐ Yes ☐ No
Recommended action:

3. Goals are developed with input from teachers, administrators, students, community representatives, and other consultants.

☐ Yes ☐ No
Recommended action:

4. Goals are written and on file.

☐ Yes ☐ No
Recommended action:

5. Goals are utilized by teachers and administrators for planning, implementing, and evaluating curriculum.

☐ Yes ☐ No
Recommended action:

6. Goals are reviewed annually and revised as necessary.

☐ Yes ☐ No
Recommended action:

Objectives

7. Written, measurable objectives are given to students and kept on file.

☐ Yes ☐ No
Recommended action:

8. Objectives are used by teachers and administrators for planning, implementing, and evaluating course content and instructional methods.

☐ Yes ☐ No
Recommended action:

9. Objectives are used as a basis for developing the technology education component of the Individualized Education Program (IEP).

☐ Yes ☐ No
Recommended action:

Content

10. Course content is developed from course objectives and uses approved curriculum guides, courses of study, and other professional resources.

☐ Yes ☐ No
Recommended action:

11. Content is offered in the broad systems of communications, construction, manufacturing, and transportation.

☐ Yes ☐ No
Recommended action:

12. Course content is selected to provide for all students.

☐ Yes ☐ No
Recommended action:

13. Content includes the development of personal and leadership skills through student organizations.

☐ Yes ☐ No
Recommended action:

14. Courses are sequential, beginning with broad orientation and exploration of subject matter areas, followed by specialized experiences.

☐ Yes ☐ No
Recommended action:

15. Course content represents the state of the art in industry and technology.

☐ Yes ☐ No
Recommended action:

16. Content is organized into course outlines, unit plans, and lesson plans, which are on file.

☐ Yes ☐ No
Recommended action:

17. A written description for each course is available to all students prior to enrollment.

☐ Yes ☐ No
Recommended action:

18. Course content is reviewed annually and revised as necessary.

☐ Yes ☐ No
Recommended action:

Scheduling

19. Technology education courses are of sufficient duration to achieve program objectives.

☐ Yes ☐ No
Recommended action:

20. Students are encouraged to enroll in courses from more than one content category during their total technology education experience.

☐ Yes ☐ No
Recommended action:

STUDENT POPULATION. All students, regardless of their age, color, handicap, national origin, race, religion, or sex, are admitted to and served by the technology education program.

Individual Differences

1. All students are provided a variety of effective and meaningful learning experiences commensurate with program goals and course objectives.

☐ Yes ☐ No
Recommended action:

2. Academically and/or economically disadvantaged students are provided special services and assistance, as required.

☐ Yes ☐ No
Recommended action:

3. Students who have physical, mental, and/or emotional impairments are provided special services and assistance, as required.

☐ Yes ☐ No
Recommended action:

4. Students identified as handicapped and requiring additional or modified educational services or materials are enrolled only after the Individualized Education Program (IEP) has been prepared.

☐ Yes ☐ No
Recommended action:

5. Students identified as gifted and/or talented are provided learning activities consistent with their abilities.

☐ Yes ☐ No
Recommended action:

6. Technology education is provided for all students, regardless of their cultural differences.

☐ Yes ☐ No
Recommended action:

7. Technology education activities are provided for all students appropriate to their maturity and/or educational level.

☐ Yes ☐ No
Recommended action:

Sex Equity

8. Females, as well as males, are encouraged to enroll in technology education.

☐ Yes ☐ No
Recommended action:

9. Technology education activities are provided for all students on a sex-fair basis.

☐ Yes ☐ No
Recommended action:

INSTRUCTIONAL STAFF. The instructional staff is both professionally and technically competent to provide students with a quality, comprehensive technology education program.

Legal/Regulatory Qualifications

1. The technology education teacher possesses a minimum of a baccalaureate degree with a major in industrial education from an accredited teacher education program.

☐ Yes ☐ No
Recommended action:

2. The teacher is competent in planning, organizing, directing, and evaluating activities in the technology education program.

☐ Yes ☐ No
Recommended action:

3. The teacher is technically competent in the assigned teaching area(s).

☐ Yes ☐ No
Recommended action:

4. The teacher eliminates sex bias and sex-role stereotyping.

☐ Yes ☐ No
Recommended action:

5. The teacher provides experiences for students with special needs.

☐ Yes ☐ No
Recommended action:

6. The teacher organizes and/or operates a local VICA chapter.

☐ Yes ☐ No
Recommended action:

7. The teacher has knowledge of the legal and liability requirements of classroom/laboratory operation.

☐ Yes ☐ No
Recommended action:

Professional Responsibilities

8. The technology education teacher is a member of and actively participates in professional and technical organizations related to technology education.

☐ Yes ☐ No
Recommended action:

9. The teacher has a professional development plan for maintaining and expanding professional and technical teaching competencies.

☐ Yes ☐ No
Recommended action:

10. The teacher participates in a minimum of one technology education-related in-service activity annually.

☐ Yes ☐ No
Recommended action:

11. The teacher maintains current knowledge in the field through activities such as reading professional and technical publications.

☐ Yes ☐ No
Recommended action:

12. The teacher is an active member of the school instructional staff, sharing in decision-making processes and participating in program promotion and staff development.

☐ Yes ☐ No
Recommended action:

13. The teacher plans and implements instruction in cooperation with counselors and other appropriate support personnel.

☐ Yes ☐ No
Recommended action:

14. The teacher has a positive attitude toward the teaching profession and demonstrates a concern for the advancement of technology education.

☐ Yes ☐ No
Recommended action:

Personal Qualities

15. The technology education teacher adheres to a written code of ethics related to the performance of professional teaching responsibilities.

☐ Yes ☐ No
Recommended action:

16. The teacher demonstrates adequate and appropriate written and oral language skills.

☐ Yes ☐ No
Recommended action:

17. The teacher provides positive leadership in the classroom, the school, and the profession.

☐ Yes ☐ No
Recommended action:

18. The teacher adheres to acceptable school practices regarding personal appearance.

☐ Yes ☐ No
Recommended action:

19. The teacher exhibits good work habits, such as safe practices, punctuality, neatness, and attendance.

☐ Yes ☐ No
Recommended action:

20. The teacher is sensitive to student needs, recognizes individual student abilities, and practices appropriate teaching methods that motivate students to maximum performance.

☐ Yes ☐ No
Recommended action:

ADMINISTRATION AND SUPERVISION. Administration and supervision are provided at all levels to ensure a well-managed and comprehensive technology education program.

Staffing

1. An adequate number of qualified state technology education supervisors is provided.

☐ Yes ☐ No
Recommended action:

2. An adequate number of local technology education supervisors is provided.

☐ Yes ☐ No
Recommended action:

3. An adequate number of qualified and certified technology education teachers is provided to meet local enrollment demands.

☐ Yes ☐ No
Recommended action:

4. A minimum of one nonteaching period for preparation is provided each day.

☐ Yes ☐ No
Recommended action:

5. Time is provided to enable the technology education teacher to organize and advise a local VICA chapter.

☐ Yes ☐ No
Recommended action:

6. Teacher aids or paraprofessionals are provided in classes where enrollment of students with special needs necessitates their assistance.

☐ Yes ☐ No
Recommended action:

Planning and Organizing

7. Supervisors and teachers use standards to plan and organize the technology education program.

☐ Yes ☐ No
Recommended action:

8. Provisions are made for local review, development, and adaptation of curriculum and instructional materials.

☐ Yes ☐ No
Recommended action:

9. Supervisors and teachers cooperatively develop specifications for technology education, equipment, and resource materials.

☐ Yes ☐ No
Recommended action:

10. Supervisors involve teachers in developing specifications for technology education, faculty design, development, and renovation.

☐ Yes ☐ No
Recommended action:

Budgeting

11. Funds are budgeted for purchase of equipment to accomplish course objectives.

☐ Yes ☐ No
Recommended action:

12. Funds are budgeted for consumable materials and supplies.

☐ Yes ☐ No
Recommended action:

13. Funds are budgeted for equipment maintenance and facility improvements.

☐ Yes ☐ No
Recommended action:

14. Funds are budgeted for instructional materials.

☐ Yes ☐ No
Recommended action:

15. Funds are budgeted for staff development, including travel, release time, and substitutes for personnel to participate in inservices, professional activities, and local, state, and national VICA activities.

☐ Yes ☐ No
Recommended action:

Directing and Monitoring

16. Written administrative policies and directives, specifically addressing the operation of the technology education program, are available.

☐ Yes ☐ No
Recommended action:

17. Teachers are visited on a regularly scheduled basis by supervisory personnel.

☐ Yes ☐ No
Recommended action:

Data Collecting and Reporting

18. Reports required by local, state, and federal agencies are prepared and submitted on schedule.

☐ Yes ☐ No
Recommended action:

19. Accurate financial reports are prepared and submitted on schedule.

☐ Yes ☐ No
Recommended action:

20. Safety reports are prepared and submitted on schedule.

☐ Yes ☐ No
Recommended action:

21. Student records are prepared, maintained, and utilized by appropriate school officials according to local, state, and federal regulations, including biographic, academic, and medical profiles on each student; and demographic data about all technology education students by grade level and by course (course enrollments by racial and ethnic categories, by sex, and by type and number of students with special needs).

☐ Yes ☐ No
Recommended action:

22. Records and related information on all advisory committee activities are prepared and distributed to appropriate staff, administrators, and other personnel.

☐ Yes ☐ No
Recommended action:

23. Records and related information on equipment, tools, textbooks, and supplies are prepared and made available to appropriate personnel.

☐ Yes ☐ No
Recommended action:

Communicating

24. Effective, open communication pertaining to all elements in the instructional program is established and used consistently among technology education teachers, administrators, school board members, supervisors, advisory committees, faculty, students, and the community.

☐ Yes ☐ No
Recommended action:

SUPPORT SYSTEMS. Support systems provide human, physical, and financial resources instrumental for attaining program goals and objectives.

Human Resources

1. School support staff and services are provided to support the technology education program, including media/instructional resource center services; assistants for special needs students; guidance services to assist all students in determining their interests, aptitudes, and abilities, in selecting the program that meets their career goals, and in explaining their individual options; interdisciplinary support; secretarial and clerical services; custodial services; maintenance services; and medical personnel to provide instruction and ensure the safety and welfare of students and faculty.

☐ Yes ☐ No
Recommended action:

2. The technology education teacher identifies and utilizes people in the community to assist in achieving program goals and course objectives, including parents and students; representatives from business and industry; and members of service/civic organizations.

☐ Yes ☐ No
Recommended action:

3. A technology education advisory committee is established and used to support the program goals and objectives.

☐ Yes ☐ No
Recommended action:

Physical Resources

4. Technology education laboratories have space consistent with suggestions in the *Guidelines for Planning Industrial Education Facilities and Equipment*, available from the DPI.

☐ Yes ☐ No
Recommended action:

5. Sufficient ancillary space is provided for storage of materials, projects/products, and tools.

☐ Yes ☐ No
Recommended action:

6. The number of students enrolled in a technology education class does not exceed the capacity and safety of the facilities and equipment.

☐ Yes ☐ No
Recommended action:

7. Facilities meet local, state, and federal health and safety standards.

☐ Yes ☐ No
Recommended action:

8. Facilities are arranged and maintained with consideration given to effective teaching, safety, class management, and economy.

☐ Yes ☐ No
Recommended action:

9. Office space is provided for each teacher within or adjacent to the technology education facility.

☐ Yes ☐ No
Recommended action:

10. Facilities are reviewed annually and modified, as needed, to accommodate changes in the course objectives and changes in technology.

☐ Yes ☐ No
Recommended action:

11. Accessibility for the handicapped is ensured through the elimination of architectural barriers.

☐ Yes ☐ No
Recommended action:

12. Bathroom facilities for both sexes are provided near or in the technology education laboratory.

☐ Yes ☐ No
Recommended action:

13. Consumable supplies and materials are provided in sufficient quantity.

☐ Yes ☐ No
Recommended action:

14. Properly maintained tools, machines, and equipment are available as needed.

☐ Yes ☐ No
Recommended action:

15. Specially designed or modified tools, machines, and equipment are provided for students with special needs.

☐ Yes ☐ No
Recommended action:

16. Equipment meets or exceeds local, state, and federal safety standards.

☐ Yes ☐ No
Recommended action:

17. Books and other instructional materials are supplied in sufficient quantity, contain sex-fair language and images, provide a wide range of role options, and meet the unique requirements of students with special needs.

☐ Yes ☐ No
Recommended action:

18. Resource materials developed or approved by the DPI are available and utilized at the local level.

☐ Yes ☐ No
Recommended action:

Financial Resources

19. The program is supported by an annual written budget based upon the program needs and student enrollment.

☐ Yes ☐ No
Recommended action:

20. Funds budgeted for supplies, equipment, and resource materials; for staff development activities; and for support of the operation of a local VICA chapter are expended as needed to fully achieve program goals and objectives.

☐ Yes ☐ No
Recommended action:

INSTRUCTIONAL STRATEGIES. Appropriate instructional strategies are designed and utilized to meet program goals, course objectives, and student needs.

Planning

1. Teachers prepare written courses of study designed to develop student competencies.

☐ Yes ☐ No
Recommended action:

2. Teachers prepare current lesson plans.

☐ Yes ☐ No
Recommended action:

3. Teachers consider alternatives and select appropriate methods to assist students in meeting course objectives.

☐ Yes ☐ No
Recommended action:

4. Teachers develop and/or obtain appropriate, up-to-date instructional materials.

☐ Yes ☐ No
Recommended action:

5. Teachers provide for evaluating the effectiveness of their instruction.

☐ Yes ☐ No
Recommended action:

6. Teachers provide input to the Individualized Education Program (IEP) committee for students enrolled in technology education.

☐ Yes ☐ No
Recommended action:

7. Teachers are involved with interdisciplinary planning within the school.

☐ Yes ☐ No
Recommended action:

8. Teachers articulate programs with business, industry, and institutions of higher education.

☐ Yes ☐ No
Recommended action:

Implementing

9. The technology education teacher uses a variety of teaching methods in conducting classroom and laboratory activities, including both teacher-centered and student-centered instructional methods; both group and individual activities; methods based upon individual student needs rather than upon the sex of the students; integration of local VICA chapter activities into planned courses of study in classroom and laboratory; and strategies appropriate for serving students with special needs.

☐ Yes ☐ No
Recommended action:

10. Student achievement is measured through a variety of testing techniques and other evaluation methods.

☐ Yes ☐ No
Recommended action:

11. Each identified special needs student enrolled in technology education is evaluated annually through procedures and criteria described in the Individualized Education Program (IEP).

☐ Yes ☐ No
Recommended action:

12. Student leadership skills are developed through a variety of curricular and extracurricular activities.

☐ Yes ☐ No
Recommended action:

Reviewing and Revising

13. Student achievement is assessed to make systematic decisions regarding the effectiveness of instructional materials and teaching strategies.

☐ Yes ☐ No
Recommended action:

14. Provisions are made for student input into the evaluation of instructional strategies.

☐ Yes ☐ No
Recommended action:

15. Provisions are made for advisory committee input into the evaluation of instructional strategies.

☐ Yes ☐ No
Recommended action:

PUBLIC RELATIONS. Various methods and media are used to inform and involve the educational community, the lay public, business, industry, and government to generate support and ensure full program implementation.

Target Populations

1. Students, parents, faculty and staff, school administrators, and members of professional teacher organizations are informed of and given the opportunity to participate in technology education programs and activities.

☐ Yes ☐ No
Recommended action:

2. The technology education faculty actively encourages community involvement and promotes a greater understanding of the program's needs and accomplishments.

☐ Yes ☐ No
Recommended action:

3. A public information plan is developed and implemented which includes active participation with government at all levels.

☐ Yes ☐ No
Recommended action:

Media

4. Radio and television are utilized to promote technology education program activities and accomplishments.

☐ Yes ☐ No
Recommended action:

5. Articles describing unique activities and accomplishments of the program are prepared and published in the local news media and in local, state, and national professional publications on a regular basis.

☐ Yes ☐ No
Recommended action:

6. Handbooks and brochures describing the technology education program, goals, objectives, and policies are prepared and used.

☐ Yes ☐ No
Recommended action:

7. Media events, including open houses, exhibits, displays, presentations, demonstrations, and technology education week activities are used to promote the program.

☐ Yes ☐ No
Recommended action:

SAFETY AND HEALTH. A written, comprehensive safety and health program is implemented to ensure safe working conditions and practices.

Program

1. A written instructional plan for safety and health is prepared utilizing community resources, administrative personnel, instructors, and safety literature.

☐ Yes ☐ No
Recommended action:

2. Safety and health instruction is included in classroom and laboratory activities.

☐ Yes ☐ No
Recommended action:

3. Proper legal monitoring is used to assess the effectiveness of the safety and health program.

☐ Yes ☐ No
Recommended action:

4. Students demonstrate acceptable knowledge, skills, and attitudes of safety and health practices and rules through written and performance tests and in-class behavior.

☐ Yes ☐ No
Recommended action:

5. Teachers and administrators review each recorded accident to correct any deficiencies.

☐ Yes ☐ No
Recommended action:

Physical Environment

6. Laboratory facilities meet safety and health laws and regulations.

☐ Yes ☐ No
Recommended action:

7. Laboratory facilities conform to acceptable technology education safety and health practices.

- Safety zones and aisles are properly marked .
- Lighting is appropriate.
- Proper exhaust system equipment removes fumes, chips, and dust from the building.
- Proper equipment heats, cools, and ventilates all instructional and ancillary areas.
- Approved safe cabinets, containers, or rooms are provided to store flammable and corrosive materials.
- Special safety and health accomodations are provided for students with special needs.
- Floors and all other surfaces are free of waste material, grease, and obstructions.
- Floors have nonskid surfaces, with special application on machine-operator work areas.
- Each laboratory with powered equipment has the equivalent of one easily accessible emergency disconnect switch (panic button) per perimeter wall.

☐ Yes ☐ No
Recommended action:

- Fire extinguishers of the correct class are provided in appropriate locations.
- A first-aid kit and related emergency supplies are provided in accordance with local regulations.

8. Machines and tools are selected, organized, guarded, color-coded, controlled, and ventilated in accordance with regulations and codes.

☐ Yes ☐ No
Recommended action:

- Equipment satisfies state and federal regulations.
- Machines and tools are arranged in a safe and functional manner.
- All machines and power tools are provided with approved commercial guards and safety devices.
- Safety guards remain in place, except when the machine is disconnected for cleaning, repair, or adjustment.
- Any machine or tool found unsafe is removed from service and marked accordingly.
- Color-coding schemes for safety purposes are used throughout the laboratory.
- Conveniently located magnetic control switches and/or control boxes and braking devices are provided for appropriate machines.
- Lockable master switch boxes are located in each laboratory.
- Machines and work stations where dust or fumes are produced beyond accepted health limits are connected to an exhaust system.

9. Personal protection devices, sanitized if necessary, are used by teachers, students, and visitors; including state or federally approved eye protection, ear protection, respiratory protection, head protection, and personal protection devices and appropriate clothing when warranted.

☐ Yes ☐ No
Recommended action:

10. Corrective and preventive maintenance is performed within a reasonable time following written notification to the appropriate administrator.

☐ Yes ☐ No
Recommended action:

Records

11. Safety and health instructional records are on file, including lesson plans documenting provisions for safety and health instruction; results of written and performance tests; and observations documenting student safety and health knowledge, attitudes, and skills.

☐ Yes ☐ No
Recommended action:

12. Records detailing current safety and health conditions in the facility are on file.
- Inspection, maintenance, repair, and replacement records are current.
- Records of each accident and the follow-up procedures taken are on file.

☐ Yes ☐ No
Recommended action:

13. Emergency procedures for responding to accidents are posted and on file.

☐ Yes ☐ No
Recommended action:

EVALUATION PROCESS. A systematic continuous evaluation program exists and utilizes standards to assess all elements of technology education programs.

Establishing a Data Collection and Analysis System

1. Teachers, administrators, and supervisors determine what aspects of the technology education program are to be included in the data collection and analysis system.

☐ Yes ☐ No
Recommended action:

2. Target sites and populations to be assessed are selected by appropriate individuals.

☐ Yes ☐ No
Recommended action:

3. Instruments, based upon the standards contained in this document, are designed and/or selected to obtain valid and reliable information.

☐ Yes ☐ No
Recommended action:

Collecting and Analyzing Data

4. Instruments are administered annually to collect valid and reliable data on selected aspects of the technology education program.

☐ Yes ☐ No
Recommended action:

5. Data on the total technology education program are collected at least once every five years.

☐ Yes ☐ No
Recommended action:

6. Data are collected in compliance with accrediting agencies and state and federal mandates.

☐ Yes ☐ No
Recommended action:

7. Valid procedures are utilized to analyze data and identify discrepancies between the current program and the standards in this document.

☐ Yes ☐ No
Recommended action:

Reporting

8. Findings from the data collection and analysis efforts are disseminated to the evaluator, the program personnel, and to appropriate decision makers.

☐ Yes ☐ No
Recommended action:

9. Discrepancies between program status and standards are reported.

☐ Yes ☐ No
Recommended action:

10. Recommendations for correcting deficiencies are reported.

☐ Yes ☐ No
Recommended action:

Decision Making

11. A written course of action is developed for overcoming each deficiency.

☐ Yes ☐ No
Recommended action:

12. Priorities are determined and actions are implemented to correct deficiencies.

☐ Yes ☐ No
Recommended action:

13. The effectiveness of the courses of action taken is assessed.

☐ Yes ☐ No
Recommended action:

SUMMARY

When these standards are used in program evaluation, a simple summary form can be filled in to indicate whether a program meets or is below the requirements for each standard, based on the number of items evaluated for each one. For each item listed as "Below Standard," a separate "Deficiency Correction Report" can be prepared. This form summarizes both the deficiency and the plan and timetable for correcting it. Samples of the "Program Evaluation Summary" and the "Deficiency Correction Report" follow.

Program Evaluation Summary

Standard	Number of Items Evaluated	Meet Standard	Below Standard
Philosopy. A current, comprehensive, written philosophical statement is available, and it influences thought and action for technology education.	5		
Instructional Program. The instructional program reflects the stated technology education philosophy through experiences designed to meet the needs of all students.	20		
Student Population. All students, regardless of their age, color, handicap, national origin, race, religion, or sex are admitted to and served by the technology education program.	9		
Instructional Staff. The instructional staff is both professionally and technically competent to provide students with a quality, comprehensive technology education program.	20		
Administration and Supervision. Administration and supervision are provided at all levels to ensure a well-managed and comprehensive technology education program.	24		
Support Systems. Support systems provide human, physical, and financial resources instrumental for attaining program goals and objectives.	20		
Instructional Strategies. Appropriate instructional strategies are designed and utilized to meet program goals, course objectives, and student needs.	15		
Public Relations. Various methods and media are used to inform and involve the educational community, the lay public, business, industry, and government to generate support and ensure full program implementation.	7		
Safety and Health. A written, comprehensive safety and health program is implemented to ensure safe working conditions and practices.	13		
Evaluation Process. A systematic continuous evaluation program exists and utilizes standards to assess all elements of technology education programs.	13		

Deficiency Correction Report

School	Date	Reported By

Standard Name	Item Number

Item *(Copy item, or part of item, being addressed.)*

Deficiency *(Briefly summarize the problem.)*

Correction of Deficiency

Priority (*check one*)
☐ High ☐ Medium ☐ Low

Person Responsible

Plan for Overcoming Deficiency

Estimated Completion Date _____

Resources Required

Estimated Cost $ _____

Date Standard Met	Signature of Person Responsible ▸	Date Signed

Vocational Industrial Clubs of America (VICA) Standards

Improving Education Through Student Organizations

In student organization activities, the development of leadership and cooperative attitudes are major objectives. Under competent guidance, students share responsibility for selecting, organizing, and evaluating group activities. Experiences are designed to help meet the leisure, social, civic, scholastic, and economic interests and needs of all students.

The primary benefits derived by students from participating in student organization activities are opportunities to

- unite in a common bond all students enrolled in trade, industrial, technical, and technology education;
- develop leadership abilities through participating in educational, vocational, civic, recreational, and social activities;
- foster a deep respect for the dignity of work;
- assist students in establishing realistic career goals;
- help students attain a purposeful life;
- create enthusiasm for learning;
- promote high standards in ethics, scholarship, quality of work, and safety;
- develop the ability to plan together, organize, and carry out worthy activities and projects through use of the democratic process;
- foster a wholesome understanding of the functions of labor and management organizations and a recognition of their mutual interdependence;
- create among students, faculty members, patrons of the school and persons in business and labor a sincere interest in and esteem for trade, industrial, technical, and technology education; and
- develop patriotism through a knowledge of our nation's heritage and the practice of democracy.

The classroom teacher also benefits from the use of student organization activities because they are effective teaching tools that

- provide interesting curricular and chapter projects;
- highlight leadership training experiences;
- assist students in making informed and meaningful educational choices;
- promote related subject areas in the school, community, state, and nation;
- motivate students toward higher levels of achievement; and
- provide for wholesome competition.

The Vocational Industrial Clubs of America (VICA) has been established to promote these concepts.

Student Organization for Technology Education

VICA

The Vocational Industrial Clubs of America is a national organization of individuals involved in coeducational secondary and postsecondary education. This includes students in trade, industrial, technical, and technology education courses.

Mission

The mission of VICA is to develop and carry out a program of activities and supportive service for student members. These activities are designed to develop the leadership and personal abilities of students as they relate to our industrial and technical world. This mission is accomplished through local chapters and state and national VICA associations.

The National Association

VICA is a national organization comprised of affiliated state associations. National VICA employs an executive director and staff that maintain a national office in Leesburg, Virginia. VICA activities at the national level assist in the growth and development of state associations. The national office staff helps to promote and manage a national conference; a competitive events program; newsletters; publications, handbooks, and chapter aids; awards and recognition programs; achievement programs; national officer's programs; national supply service; and assistance for state association and local chapter planning.

State Associations of VICA

Local school chapters of VICA are affiliated with the state association. The association of local chapters provides benefits and operational support to technology education on a statewide basis.

State activities may include a state conference for students and teachers; a state officer program; newsletters and publications; competitive events, awards, and recognitions; and leadership and in-service workshops.

Recognition

VICA's mission has been officially recognized and endorsed by the

- United States Department of Education;
- American Vocational Association;
- National Association of Secondary School Principals;
- Wisconsin Department of Public Instruction;
- National Coordinating Council for Vocational Student Organizations; and the
- Wisconsin Board of Vocational, Technical, and Adult Education.

Standards for Achieving a Successful VICA Student Organization

Philosophy

- Students, including local VICA chapter members, are involved in developing the philosophical statement.
- The local philosophy encourages development of personal and leadership skills through VICA.

Instructional Program

- Emphasis is placed upon developing leadership ability, encouraging and promoting responsibility, and developing positive social interaction through VICA.
- Course content includes the development of personal and leadership skills through VICA.

Instructional Staff

- The technology teacher is prepared, through preservice/inservice education, to organize and operate a local VICA chapter.

Instructional Strategies

- Local VICA chapter activities are integrated into planned courses of study and are utilized in conducting classroom and laboratory activities.

Administration and Supervision

- One fulltime, or equivalent, VICA advisor is provided in each state.
- Time is provided to enable the technology education teacher to organize and advise a local VICA chapter.
- Funds are budgeted for travel, release time, and substitutes for personnel to participate in local, regional, state, and national VICA activities.

Support Systems

- Budgeted funds are expended to support the operation of a local VICA chapter.

Public Relations

- Students promote and support technology education programs through involvement in activities including VICA.

Sample Forms

D

Applications of Technology Program

Application

Student Name

Application Area *Check only one:*

☐ Communications ☐ Construction ☐ Manufacturing ☐ Transportation ☐ _____ *Specify*

Previous technology education courses taken:

Briefly describe your goals after leaving high school (occupation, vocational training, college):

Explain how this course will assist you in reaching your goals:

Reason(s) for taking course *Indicate primary focus:* _____

☐ Occupational Preparation *Specify occupation:* _____

☐ Preparation for Additional Education *Program or major:* _____

School or college: _____

☐ Enrichment—hobby, life skills

The Applications of Technology course can take different directions. Within the focus you noted above, *check your intended area of concentration:*

☐ Creating Technology
☐ Using Technology
☐ Servicing Technology
☐ Teaching Technology
☐ Managing Technology

Some methods that your instructor will consider using in this course are listed below. Your course may include several or all of them. *Mark those that have special appeal to you:*

☐ Research and Development
☐ Entrepreneurship
☐ Work Experience
☐ Classroom Simulation
☐ Group Discussion/Lecture
☐ Other *Specify* _____

Briefly describe how you would like to see this Applications of Technology experience operate for you:

Independent Study Program

Independent Study Program Information

1. Who is eligible for independent study?

   All students are eligible to apply regardless of grade-point average.

2. How much credit can be earned?

   One (1) Carnegie Unit (equivalent—2 semester courses) per year can be earned in this program. This could be one large or two small studies; a full unit could be earned in one semester.

3. Who can be an advisor for independent study?

   Any teacher on the faculty may serve as an advisor. Each teacher may handle up to five students on independent study projects at one time, depending on the teacher's background and time available.

4. Other information and requirements for the program.

   A. Independent study will not take the place of the regular academic requirements needed to graduate, but the study could be related to a regular subject area.

   B. Independent study hours required will be equivalent to regular semester courses. Regular semester courses equal 90 hours, and independent study requires at least 100 hours, depending on the study.

   C. An independent study committee, consisting of three teachers, one counselor, and one administrator will serve as the screening, evaluation, and accrediting body. The committee will also establish a timetable for the project.

   D. The grade of A, B, C, or No Credit will be determined by the advisor with approval by the committee.

Procedures for Students on Independent Study

Develop an idea.

- A topic will be explored in an in-depth study with obvious educational value.
- Select a tentative title for the project.

Obtain an advisor and receive counsel.

- Arrange for a faculty advisor.
- The advisor must have knowledge in the subject area of the study.
- Each teacher may have up to five (5) students on independent study at one time depending on the instructor's available time.
- The advisor is to provide leadership, advice, and direction during the independent study project.

Develop an instruction plan.

- Write behavioral objectives to cover the project or topic adequately.
- Evaluation procedures should be developed for the study.
- The objectives and the evaluative procedures are to be developed in cooperation with the advisor.
- A completed instructional plan is to be submitted to the independent study committee at least three days prior to their proposal meeting.

The independent study committee will meet to discuss the proposal.

- The meeting will be called by the committee at the request of your advisor.
- You and your advisor will be present to discuss the proposal.

The Committee will evaluate your proposal, give approval for, or suggest alterations of, the proposal, and establish a timetable.

It is your responsibility to work on and complete the independent study project by

- keeping the advisor appraised on progress;
- scheduling three or more in-depth meetings with your advisor each quarter; and
- consulting with your advisor to determine if goals and objectives have been accomplished.

An evaluation of the project by the independent study committee will be made.

- The committee will schedule the evaluation meeting at the request of your advisor.
- You will present an oral review of the project to the committee.
- The committee will evaluate objectives of the independent study project.
- The committee will approve the amount of credit, with the grade to be determined by the advisor.

Independent Study Contract

The "Independent Study" course (Level V) consists of activities related to the technology of energy, power, and transportation. These activities include reading, writing, discussing, participating in selected "hands-on" activities, and completing one research and development project. As part of each "hands-on" activity, an "Achievement Contract" is to be completed. The contract includes objectives, a time estimate, suggested procedure, and an evaluation system. Completion of the form is required before the activity is started.

Two written homework activities related to the "hands-on" activities are required. The first is a narrative describing one of the activities. It will be evaluated on neatness, organization, grammar usage, content, and length. Additional credit will be given for using a word processing system. The second is a photo instruction sheet. Use it to illustrate the procedure necessary to complete one of the contracted activities. Use at least ten photos accompanied by appropriate captions, mounted on 8.5" x 11" paper in a loose-leaf folder. The photographs must be taken in the high school technology rooms. Evaluation will be based on neatness, organization, clarity, sequence, proper tools, and proper procedure.

Two other homework activities are also required. The first is written reviews of four recent technical articles related to energy, power, or transportation. Reviews will be evaluated on neatness, accuracy, completeness, and appropriateness. The second is a notebook containing information on all the units of instruction, any assignments related to the activity units, tests, and other information. Notebooks will be evaluated on neatness, organization, and content.

Course evaluation will be based on classroom behavior, including safety and maintenance (daily clean-up, periodic repairs, equipment maintenance, and organization), the quality of work completed, and cooperation (acting in a manner conducive to the safety and best interest of all persons and equipment). Activities submitted after the class period on the due date will receive no credit unless illness, accident, or other unavoidable occurrence can be proven.

Your signature on this contract indicates your awareness of the course requirements, willingness to cooperate and complete the required activities, and recognition that failure to do so will result in failure to receive course credit.

— Due Dates —

Narrative _____ *Mo./Day/Yr.*

Article Summaries _____ *Mo./Day/Yr.*

Photo Instruction Sheet _____ *Mo./Day/Yr.*

Notebook _____ *Mo./Day/Yr.*

Research and Development Project _____ *Mo./Day/Yr.*

Student Signature ▶	Date Signed
Parent Signature ▶	Date Signed

Technology Education
Independent Study Achievement Contract

Student Name	
Content Area	Activity Title
Starting Date *Mo./Day/Yr.*	Completion Date *Mo./Day/Yr.*
Specific Objectives *Indicate what you intend to achieve from this study:*	
Procedure	
Evaluation System	
Instructor Approval Signature ▸	Date of Approval
Instructor Evaluation Signature ▸	Date of Evaluation

Application for Independent Study and Proposal Cover Sheet

Student Name *Please print*	Student No.	Room No.	Birth Date

Title of Independent Study

Advisor/s	Projected Completion Date

Instructional Plan *Refer to page number(s)* _____ *in proposal.*

Objectives *Refer to page number(s)* _____ *in proposal.*

Evaluate Procedures *Refer to page number(s)* _____ *in proposal.*

Other Requirements *Refer to page number(s)* _____ *in proposal.*

Parent Signature ▸	Date Signed

FOR OFFICE USE ONLY

Date Applied	Date Approved

Completion Date *Set by Committee*

Date of Credit Approval	Amount of Credit

COMMENTS:

Signature/s of Advisor/s ▸	Date Signed

Signature of Principal ▸	Date Signed

Signature of Chairperson or Committee Member ▸	Date Signed

VICA Forms

Field Study Program

The purpose of the Vocational Industrial Clubs of America (VICA) is to further enhance the educational objectives of the technology education program. The program is designed for those students who have a definite interest in, or a career goal of working in, a trade/related manufacturing industry. Students who wish to participate in the program will study and take notes on their observations and discussions with a manufacturing worker during the two (2)-day period. The observations will take place during the school day at locations within the district.

Objectives of the Program

1. To provide students with the opportunity to observe a skilled employee working at a job.
2. To allow students to explore the manufacturing industry in which they are being trained.
3. To have students write a report about their observations and communicate the report orally to the rest of the class.

Observation Requirements

1. A written and/or typed report of not less than one page and not more than three pages will be due three days after returning to school.
2. An oral report also will be given to the class about the field study placement. The report will be scheduled by the instructor.

Sample Outline

I. Report title page

II. Introduction

- A. Company, job site, person observed
- B. Job description of worker

III. Main part

- A. Product or part being manufactured
- B. Capabilities of machine
- C. Unusual setups, jigs, and fixtures used
- D. Types of cutters–speeds and feeds
- E. Use of measuring tools and print reading
- F. Job requirements and training needed
- G. How computers are being used

IV. Summary and comments

Program of Work

The program of work is a yearly plan for chapter activities that relates directly to the organization's overall objectives. All state vocational student organizations submit a plan of work in accordance with instructions from the Wisconsin Department of Public Instruction's student organization advisor.

Following is the format of the program of work that is recommended for use by all VICA chapters. Advisors and students will find it useful in planning and evaluating activities for the VICA year.

Chapter Information

School	Chapter Membership
Chapter Advisor	Program Enrollment

Chapter Program of Work

State Goals	Chapter Objectives to Achieve State Goals	Evaluation Process to be Used
Enable students to demonstrate and further develop the competencies important to success in technology and health-related occupations		
To inspire and develop leadership abilities in students		
To improve the human relationships of students		
To improve the self-image and success pattern of students		
To enable students to demonstrate and further develop their responsibilities as citizens in our free enterprise system		
To help students further identify their personal career goals		
To secure the involvement and support of educators, business people, legislators, and parents for education in technology and health-related occupations		
Additional objectives arrived at locally		

For assistance, contact your state technology education consultant.

Wisconsin Department of Public Instruction
125 South Webster Street
P.O. Box 7841
Madison, WI 53707

You can also write National VICA for additional information.

Vocational Industrial Clubs of America
P.O. Box 30090
Leesburg, Virginia 22075

"END OF DOCUMENT"